NICOLET SCIENTIFIC CORPORATION

MODEL /S

FREQUENCY SYNTHESIZER

NICOLET SCIENTIFIC CORPORATION
(formerly Federal Scientific Corporation)
245 LIVINGSTON STREET, NORTHVALE, NEW JERSEY 07647

NICOLET SCIENTIFIC CORPORATION

Serial Number _____

Instruction Manual

for

MODEL /S

FREQUENCY SYNTHESIZER

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NICOLET SCIENTIFIC CORPORATION / 245 LIVINGSTON ST., NORTHVALE, N. J. 07647 (201) 767-7100
(formerly Federal Scientific Corporation)

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Sincerely,

Henry J. Bickel
President

NICOLET SCIENTIFIC CORPORATION

FOREWORD TO THE OPERATING MANUAL FOR THE MODEL /S FREQUENCY SYNTHESIZER

August 1975

1. INTRODUCTION.

Operational and maintenance information covering the Model /S Frequency Synthesizer is presented in the following pages of this Instruction Manual. The Model /S Frequency Synthesizer is manufactured by Comstron Corporation, Richmond Hill, New York.

2. OPERATION.

Refer to the appropriate section in the Range Translation Unit Instruction Manual, Model 30 Series for operation of this Frequency Synthesizer, for range translation applications.

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TABLE OF CONTENTS

Section 1	General Information
1.1	Introduction
1.2	Specifications
Section 2	Installation
2.1	Mechanical Installation
2.2	Electrical Installation
Section 3	Operating Instructions
3.1	Introduction
3.2	Description of Front Panel
3.3	Description of Rear Panel
3.4	Special Operating Notes
3.5	Programming (Option 001; BCD Programming)
Section 4	Circuit Description
4.1	Mechanical Arrangement
4.2	Simplified Block Diagram
4.3	Power Supply
4.4	Display and Controls
4.5	Divide-By-N Counters
4.6	Sample and Hold Circuits
4.7	Voltage Controlled Oscillators
4.8	Program Voltage
4.9	Clock Generator
4.10	Range Dividers and Mixer
4.11	Output Section
4.12	Remote Programming (Option 001)
Section 5	Maintenance
5.1	Introduction
5.2	Service Information
5.3	Performance Checks
5.4	Calibration Procedure
5.5	Troubleshooting
5.6	Table of Test Points

Section 6 Schematics and Parts Lists
6.1 Introduction
6.2 Schematic Notes
6.3 Manufacturers' Code
6.4 Schematics
6.5 Parts Lists

SECTION 1
GENERAL INFORMATION

1.1 INTRODUCTION

The Comstron-Seg Model 1013 Frequency Synthesizer is a 5 digit decade ranged synthesizer providing a constant 10 parts per million resolution. Direct Programming Differential Synthesis (patent pending) locks all 5 digits to a temperature compensated crystal reference. The unit features low spurious and harmonic distortion coupled with superior phase noise characteristics which makes the Model 1013 the ideal signal source for both bench and system applications.

Table 1-1 lists the specifications for the Model 1013 Frequency Synthesizer

TABLE 1-1.
SPECIFICATIONS

FREQUENCY SYNTHESIZER

MODEL 1013

FREQUENCY

Ranges	0.1Hz to 13MHz in 5 ranges 0.1Hz to 1.0kHz 1kHz to 13kHz 10kHz to 130kHz 100kHz to 1.3MHz 1.0MHz to 13MHz
Resolution	Range — Resolution 1kHz — 0.1Hz 10kHz — 0.1Hz 100kHz — 1Hz 1MHz — 10Hz 10MHz. — 100Hz
Accuracy	±0.001% for 6 months 0°C to 50°C
Stability	Long Term: ± 10 parts in 10^6 per year with ambient temperature reference

SIGNAL PURITY

Signal to Phase Noise (Integrated)	Phase noise to Signal Ratio measured in a 30kHz band excluding ± 1Hz centered on carrier.

Frequency Range	Phase Noise
0.1Hz to 130kHz	−80dB
100kHz to 1.3MHz	−60dB
1MHz to 13MHz	−40dB

Harmonic Distortion	Frequency Range	Harmonic Distortion
	0.1Hz to 1MHz	−50dB
	1MHz to 13MHz	−40dB

Spurious	Greater than 60dB down

OUTPUTS

Amplitude	6V RMS open circuit 3V RMS into 50 ohms
Amplitude Range	+23dBm to −40dBm
Output Impedance	50 ohms
Frequency Response	±0.25dB 1Hz to 13MHz
Square Wave Output	Drives 50 ohms with TTL Logic Levels. Rise and fall time less than 5 nanoseconds

GENERAL

Operating Temperature	0° to 50°C
Storage Temperature	−40°C to +70°C
Power Requirements	115V or 230V ± 10%, 48 to 64Hz, 50W
Weight	20 lbs. (9kg)
Dimensions	16¾"W x 5¼"H x 18¾"D (426 x 133 x 470mm)

OPTIONS

Parallel BCD Frequency Programming

001

Field Installable. Allows remote programming of frequency. All 5 digits plus overrange and range may be programmed to full crystal accuracy.

Control Lines Required: 26 plus remote.

Logic Levels: TTL, "1" state low, non-isolated.

Frequency switching and settling time: 10ms to within ±0.001% of range, worst case.

Programmable Attenuator

002

Attenuation Range: +22.9dBm to −69.9dBm of attenuation in 0.1dB steps.

Switching and Settling Time: 5ms.

Parallel BCD Programming: 3 digits plus sign.

Control Lines Required: 16 plus remote.

Logic Levels: TTL, "1" state low, non-isolated.

ASCII Programming—Frequency and/or Amplitude
003

Field Installable.
Control Lines Required:
Input: 7 "program data" lines
1 "data strobe" line
1 "remote enable" line
Output: 1 "data flag" line
1 "delay flag" line
Logic Levels: TTL

Ultra-Stable Reference Oscillator
004

Field Installable.
Short Term Stability: ± 1 part in 10^8/day.
Long Term Stability: ± 1 part in 10^6/year.

External Reference Lock
005

Frequency: 1MHz
Amplitude: 200mV rms minimum
2 V rms maximum

75 Ohm Output Impedance
006

SECTION 2
INSTALLATION

2.1 MECHANICAL INSTALLATION

After unpacking the instrument, visually inspect the external parts for damage. Retain the shipping container and packing material in case it is necessary to reship the unit.

If the instrument is received mechanically damaged in transit, notify the carrier and either the nearest Comstron-Seg representative or the factory in Richmond Hill. If the shipping container is damaged, retain the container and packing material for inspection by the carrier.

The instrument can be rack mounted utilizing the appropriate mounting accessories described in the Accessories section.

2.2 ELECTRICAL INSTALLATION

These instruments operate from either 115V AC or 230V AC as selected by a slide switch located on the rear panel. Before operating the instrument, check that the fuse mounted in the fuse holder and the slide switch correspond to the supply mains. The power supply has been designed to operate from 47Hz to 400Hz. The fuse should be rated at 3/4 A for 115V, and 1/2 A for 230V operation.

The electrical performance of this instrument can be verified utilizing the procedures outlined in Section 5, Maintenance.

SECTION 3
OPERATING INSTRUCTIONS

3.1 INTRODUCTION

This section provides complete functional control description, operating instructions and descriptions of instrument set ups.

3.2 DESCRIPTION OF FRONT PANEL (Refer to Figure 3-1 for control location)

This section provides complete functional control description, operating instructions and descriptions of instrument set-ups.

(1) POWER	Toggle switch applies power to the unit when flipped to the up position
(2) REMOTE	LED when lighted indicates unit is under remote control. When illuminated front panel controls (3), (5) are disabled. LED frequency indication (4), (6), (7) remain operational.
(3)	Rotary switch selects range. Range indicator (4) shows selected range. When lowest range (Hz) is selected, the most significant digit as well as the overrange digit are suppressed to permit operation below 1000.0 Hz.
(4)	Indicators show selected frequency range Decimal point of frequency readout (6) is automatically placed. Instrument should be used on lowest possible range for best performance.
(5)	Rotary Switches select frequency. Each digit is selected by associated switch. Switches do not have stops and therefore permit selection from 0 to 9 and 9 to 0 in a single step.

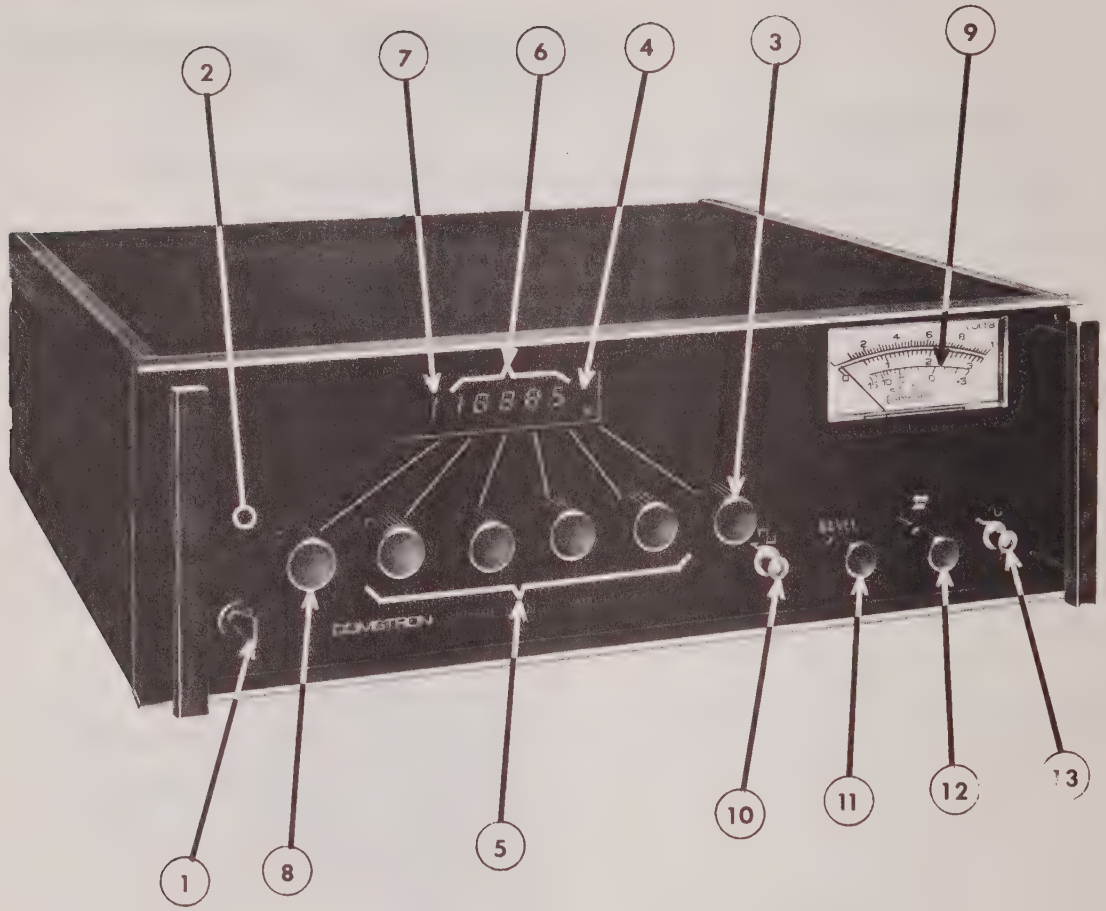


Figure 3 -1 - FRONT PANEL

(6)		LED digits indicate output frequency of unit. Rotary switches (5) control digits. Rotary switch (8) controls overrange digit as well as * MSD for MHz and kHz ranges. The overrange digit and MSD are blanked and set to zero when the range (4) is Hz.
(7)		LED digit used only for overranging, thus is either blanked or is "1" - controlled by rotary switch (8)
(8)		Rotary switch sets MSD of (6) and overrange digit (7). Switch selects numbers from 1 to 12 and has stops at 1 and 12.
(9)		Meter shows output voltage and power level referenced to a 50 ohm termination. Used in conjunction with LEVEL control (11) and attenuator (12)
(10)		BNC connector output square wave of TTL logic levels can drive 50 ohms
(11)	LEVEL	Level control sets level in conjunction with attenuator (12)
(12)		Rotary switch attenuator provides attenuation in 10dB steps
(13)		BNC connector output sinewave, 50 ohm output impedance. Must be terminated in 50 ohms for correct meter indication.

* MSD = Most Significant Digit

3.3 DESCRIPTION OF REAR PANEL (Refer to Figure 3-2 for location)

(1)	Fuseholder	3/4 Amp 3AG fuse at 115V AC 1/2 Amp 3AG fuse at 230V AC
(2)	Voltage Switch	Conditions unit to accept either 115 volts or 230 volts AC 47 to 400 Hz. NOTE: Make certain voltage switch is in correct position before plugging unit into power mains.
(3)	Line Cord	Standard AC line cord (3 wire)
(4)	Line Cord Wrap	Provision for line cord storage
(5)	Programming Connector (Option 001, Option 003)	
(6)	Reference Input (Option 005)	

3.4 SPECIAL OPERATING NOTES

3.4.1 TERMINATIONS

The output level meter is calibrated in dBm and in volts referenced to a 50 ohm termination. If the output is used in a misterminated or unterminated condition, the meter will not indicate the true output voltage or power. At low frequencies, it may be advantageous to operate the unit unterminated to achieve a higher voltage output (up to 20V p - p). The output voltage will be approximately twice that of the meter reading; rms, while the power reading has no meaning.

3.4.2 SQUARE WAVE OUTPUT

The square wave is driven from a T^2L driver gate and may, therefore, be terminated in 50 ohms if desired. Since the square wave is generated through a comparater from a sinewave, when using the square wave output the meter should be as high up the scale as possible. If the meter reads downscale or below scale, square wave symmetry may be impaired, or the square wave may not be generated.

3.4.3 OVERANGING

The output frequency should be set on as low a range as possible for best performance. For example, 1.1MHz can be set as 1.1000MHz or 1100.00kHz. Although the frequency output is the same, phase noise of the 1100.00kHz setting is 20dB better than the 1.1000MHz setting, and an additional digit of resolution is obtained.

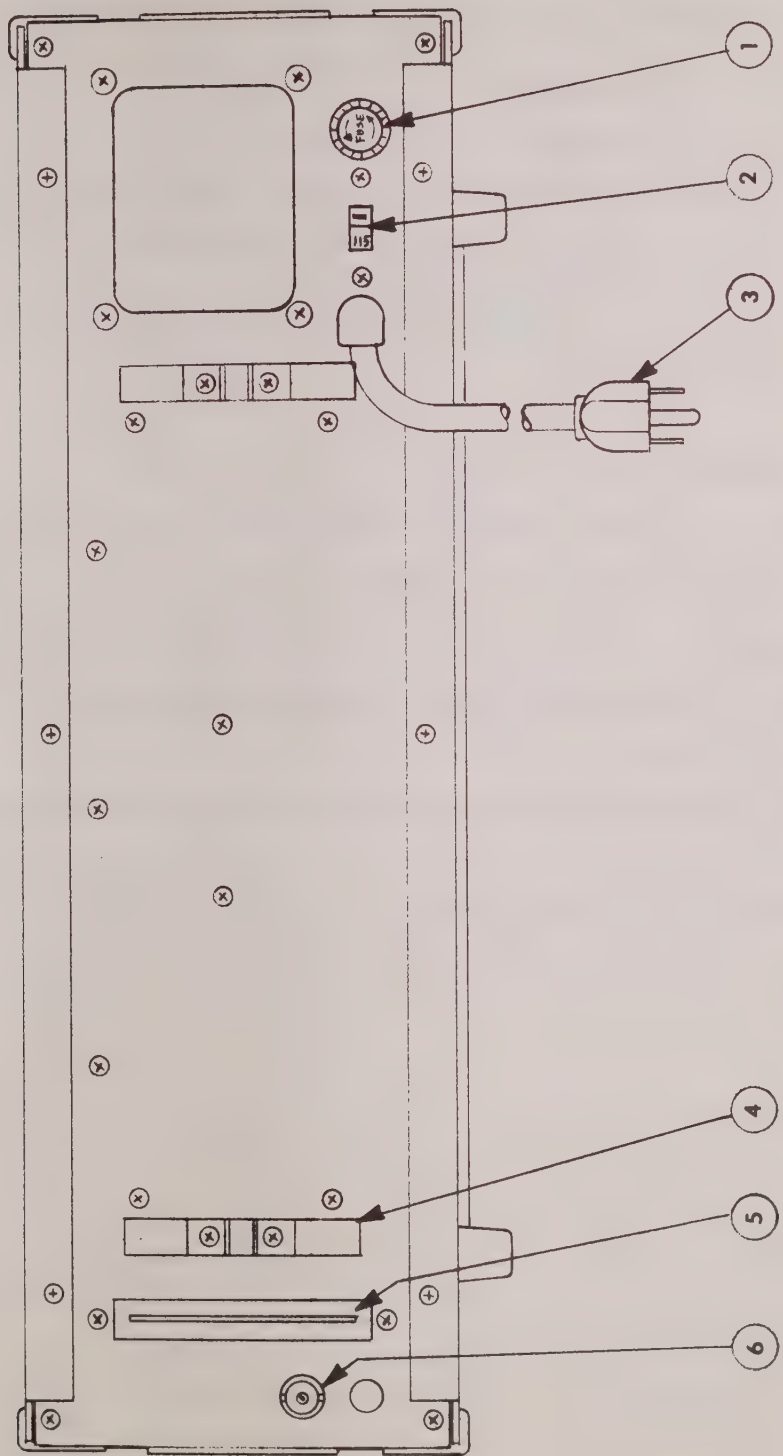


Figure 3 - 2 - REAR PANEL

3.4.4 LEVEL

In general the unit should be operated with the output meter as far upscale as possible, for best output level accuracy. Thus when two settings can be used to obtain a desired output level, the setting that causes the output meter to read upscale should be used.

3.4.5 HARMONICS

For applications where minimum harmonic distortion is desired, the unit should be used with the output meter reading below full scale. Generally a 5 to 10dB improvement can be obtained by setting the output level such that the meter reads at the 0dBm mark. This is independent of the 10dB attenuator position.

3.5 PROGRAMMING (Option 001; BCD Programming)

Connections for remote operation are made via the 50 pin card edge connector on the rear of the unit. The data inputs must be negative true T^2L compatible logic. The unit is placed in remote operation by grounding or applying a low logic signal to pin 31. When the unit is powered up, or when first placed in the remote condition, the output signal is inhibited and the front panel display is blanked except for a leading "1".

The unit indicates that it is in the remote condition by showing an "R" on the front panel.

Care must be taken in connecting the data lines with respect to ground currents and noise. When operating in a noisy environment or at long distances from the program source, isolation such as opto-isolators may be required.

REMOTE BCD PROGRAMMING

GENERAL

The Model 1013 Option 001 provides for remote BCD programming of frequency and amplitude (is applicable) from TTL logic levels. (1 = low state) All front panel functions except POWER ON are programmable; 5-1/2 digits (21 bits BCD) of frequency, 5 ranges (3 bits BCD code) and 3 digits of amplitude in dBm (11 bits BCD and 1 sign bit). Frequency and amplitude are strobed from separate control lines and can be strobed separately or together. When the remote line is activated on the interface control, the front panel controls are rendered inactive.* The BCD data are internally stored in the standard option for ease of interfacing to various types of equipment.

*LED readout is still active and displays the current state of the instrument.

INTERFACE ORGANIZATION

The interface is organized into 3, 12 bit data words each with a separate strobe for loading the storage registers. The strobes, Frequency Strobe 1, Frequency Strobe 2 and Amplitude Strobe, can be tied together for fully parallel operation or, if desired, each 12 bit word can be loaded separately. For 12 or 16 bit Bus operation, data inputs can be tied together and strobed on a time shared basis, if driven from TTL - Buffer/Driver Gates.

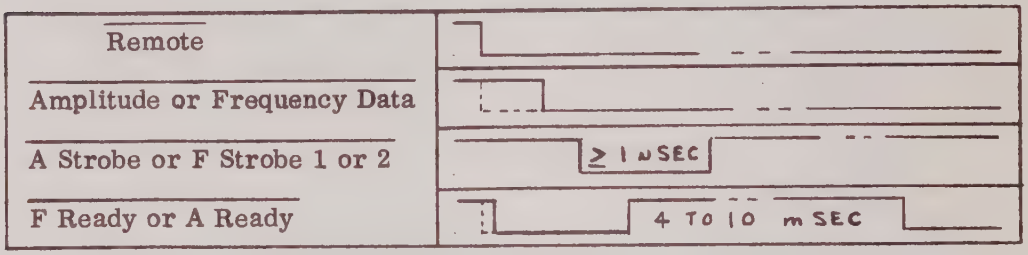
Figures 1 and 2 show the organizational structure.

FREQUENCY

The program source must provide 5 BCD digits and 1 bit overrange plus 3 bit octal code for range 1 to 5 when programming frequency.

Min	Max		Range	Range Code	Leveling
1.0000	13.0000	MHz	1	001	IN
100.00	1300.00	kHz	2	010	IN
10.000	130.000	kHz	3	011	IN
1000.0	13000.0	Hz	4	100	IN
000.1	999.9	Hz	5	101	OUT

The $\overline{\text{Remote Enable}}$ line must be held low for at least 10usec before loading and held low for the duration of remote operation. To load frequency and range information $\overline{\text{F Strobe 1}}$ and $\overline{\text{F Strobe 2}}$ must pulse ⌐⌊⌐ for greater than 1 usec. $\overline{\text{F Ready}}$ is provided back in 5 to 10 msec indicating frequency is within .001% of programmed (worst case). A $\overline{\text{Unit Ready}}$ signal is provided to indicate the unit is powered up.



When programming frequencies less than 1kHz, the unit should be programmed in range 5 to assure meeting amplite levelling specifications.

F100K	F10K	F1K	F100	F10	F1	Range
0 - 1	0 - 9	0 - 9	0 - 9	0 - 9	0 - 9	1 - 5
1 bit	4 bit BCD	4 bit BCD	4 bit BCD	4 bit BCD	4 bit BCD	3 bit Octal
*4	*1					*3
*2	*2 *4					

NOTES:

1. On ranges 1 to 4 this digit should be 1 or greater.
2. On range 5 these digits should be 0.
3. Codes for 0, 6 and 7 is invalid.
4. Number greater than 13 in these digits is invalid.

AMPLITUDE

The Program Source must provide 2 BCD digits, 1 Octal digit and 1 sign bit (+ low). The timing sequence for storing the information is the same as for frequency and can be done simultaneously or separately with respect to frequency. After A Strobe, A Ready is

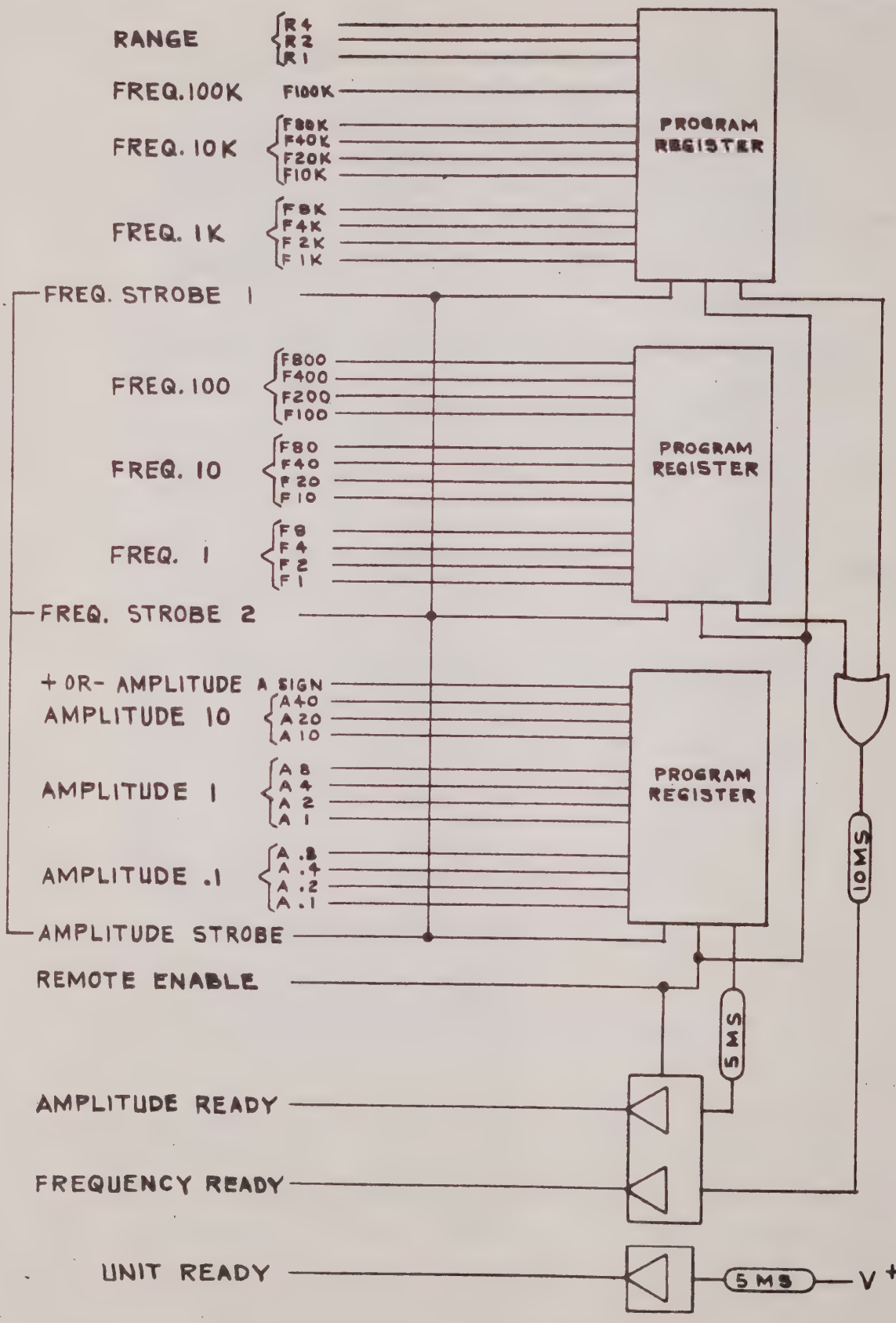
returned indicating that amplitude is within specifications and is provided within 4 to 6 msec (worst case).

Sign	10dB	1dB	.1dB
+ or -	3 bit Octal	4 bit BCD	4 bit BCD
Low = +	(+) 0 - 2	0 - 9	0 - 9
	(-) 0 - 7		

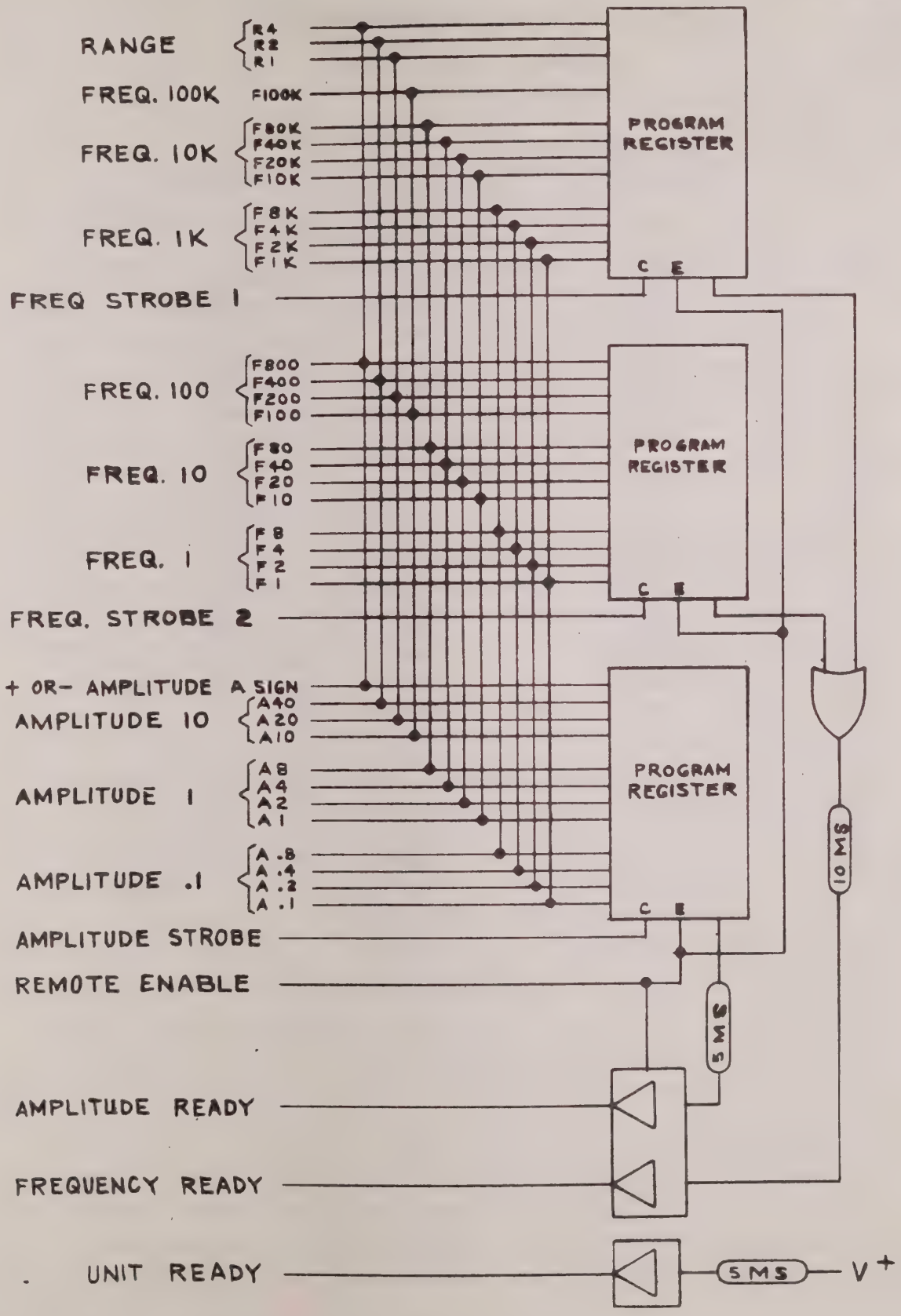
CONNECTION

Rear Panel Connector is 50 contact, .1 inch center P.C. card edge connector.

The P.C. card is supplied with Option 001.



FULL PARALLEL APPLICATION



MULTIPLEX BUS APPLICATION

MODEL 1013 Remote BCD Programming

Connector Wiring

Options 001 and 002

Pin No.	Function	Pin No.	Function
1	F10	26	-
2	F2	27	-
3	F8	28	A Ready
4	F4	29	Unit Ready
5	F80	30	-
6	F40	31	Remote
7	F20	32	GND
8	F1	33	R4
9	F200	34	R2
10	F800	35	R1
11	F400	36	F80K
12	F100	37	F40K
13	F20K	38	F100K
14	F2K	39	A0.1
15	F1K	40	A0.2
16	F4K	41	A0.4
17	F2 Strobe	42	A0.8
18	F1 Strobe	43	A1
19	F8K	44	A2
20	F10K	45	A4
21	-	46	A8
22	-	47	A10
23	-	48	A20
24	F Ready	49	A40
25	A Strobe	50	A $\pm$

F: Frequency

R: Range

A: Amplitude

Note: All functions are negative true logic

SECTION 4
CIRCUIT DESCRIPTION

4.1 MECHANICAL ARRANGEMENT

The basic 1013 frequency synthesizer is comprised of four printed circuit board assemblies. The power supplies, mounted on the rear panel, the frequency generation circuitry mounted on the top of the central shelf, the range dividers and output circuitry mounted on the bottom of the central shelf and the display and controls circuitry mounted on the front panel. The mechanical arrangement and interconnection is described in the Maintenance Section 5.

4.2 SIMPLIFIED BLOCK DIAGRAM

The COMSTRON-SEG Model 1013 uses Direct Programming Differential Synthesis (patented) as the fundamental frequency generation method. This technique locks all digits to a stable crystal reference with wideband phase locked loops providing superior phase noise characteristics, as well as low spurious and harmonic distortion.

Referring to the Simplified Block Diagram of Figure 4-1

The frequency generation section of the 1013 is composed of two phase-locked ÷N loops. The main loop provides frequencies from 19.8MHz to 33.78MHz in 10kHz steps while the vernier loop provides frequencies from 19.8MHz to 20.7801MHz in 9.9kHz steps. The main loop and vernier loop difference frequency is formed in the wideband mixer. By appropriately choosing a programming algorithm the difference frequency can be chosen in 100Hz steps. This is illustrated by considering an increment of 10kHz in the main loop and a 9.9kHz increment in the vernier loop; although the loop frequencies have incremented by 10kHz and 9.9kHz respectively, the difference frequency has incremented by 100Hz. Thus the attributes of wideband loops can be utilized while permitting small frequency increments.

The vernier loop frequency is used as the RF signal in a double balanced mixer while the main loop frequency is used as the LO drive. Since the vernier loop frequency covers a relatively narrow frequency range, a band pass filter can be used to form a low distortion of signal. The resultant difference frequency is also low distortion - the sum frequency and LO frequency are removed with the low pass filters.

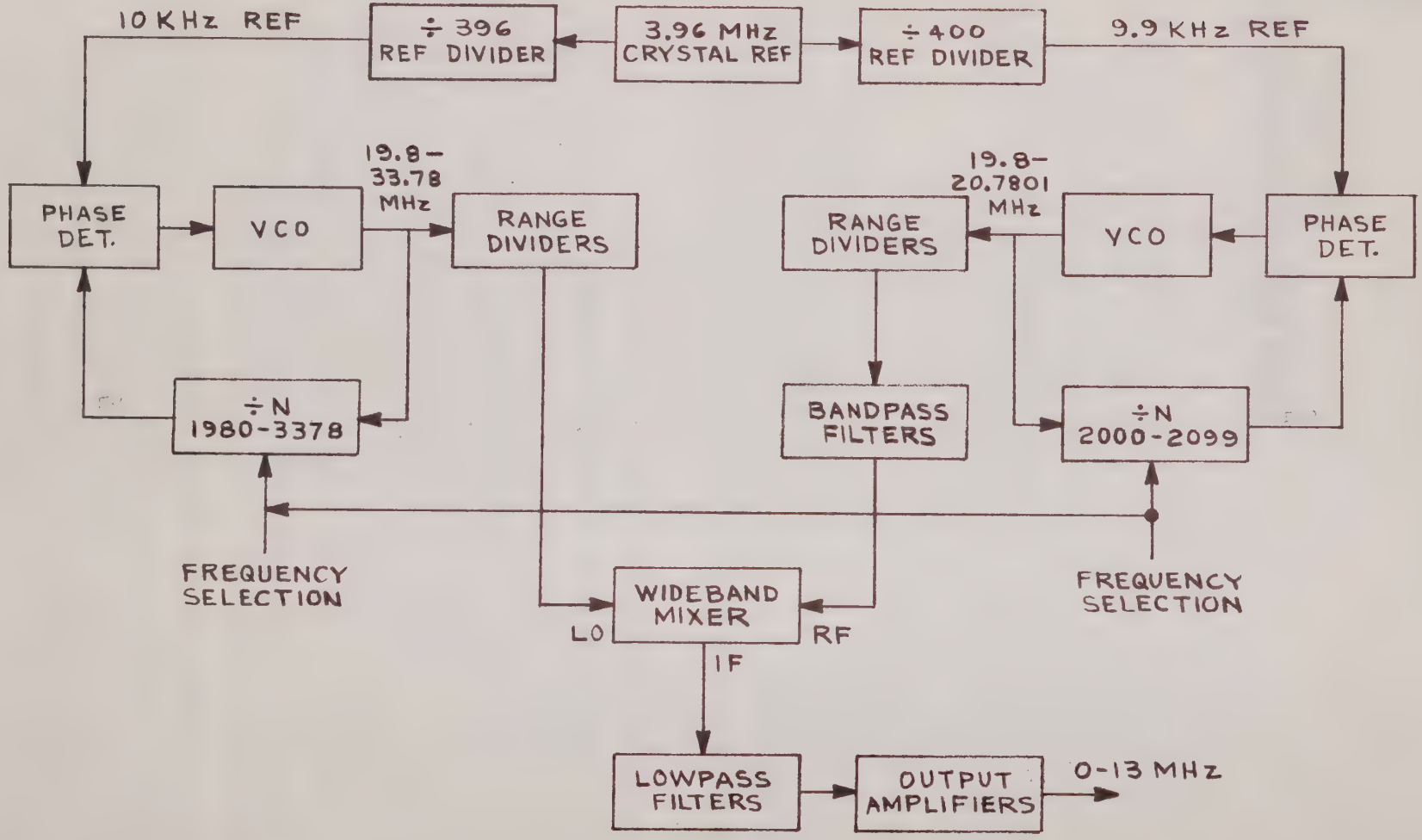


FIGURE 4-1 SIMPLIFIED BLOCK DIAGRAM

The instrument is downranged by dividing the main loop and vernier loop frequencies in the decade dividers before taking the frequency difference. Each decade of downranging increases the absolute resolution by one digit and therefore maintains a constant 10 part-per-million resolution. Dividing the main loop and vernier loop frequencies also improves the phase noise or short term stability by 20dB for each decade of division.

The output amplifiers amplify the signal to provide a maximum +23dBm into a 50 ohm load with a 50 ohm output impedance.

Example of Frequency Selection

Label the selected digits A, B, C, D, E where A is the most significant digit and E is the least significant digit. A therefore corresponds to the leftmost frequency selection rotary switch when facing the unit, and E corresponds to the rightmost exclusive of the range control. The ÷N counters within each loop are programmed in accordance with the following algorithms

Main Loop	Vernier Loop
1980	2000
+ ABC	+ DE
+ DE	
N	N

Thus if we wish to select 3.1416MHz:

The Main Loop ÷N is programmed to

```
  1980
+  314
+   16
  2310
```

The output frequency of the main loop is thus

2310 x 10kHz = 23.1 MHz

The Vernier Loop ÷N is programmed to:

```
  2000
+   16
  2016
```

The output frequency of the vernier loop is thus

2016 x 9.9kHz = 19.9584MHz

The difference frequency formed in the wideband mixer is:

```
   23.1      MHz
 - 19.9584   MHz
   3.1416    MHz
```

which is the desired frequency.

The lower ranges are programmed similarly with respect to the loop frequencies but the output loop frequencies are divided before mixing. Thus if a frequency of 314.16kHz is desired, the loops are programmed as above, but the output loop frequencies are divided by 10 to 2.31MHz and 1.99584MHz for the Main Loop and Vernier Loop respectively. The Bandpass Filters and Lowpass Filters are switched and the mixer output difference frequency is .31416MHz or 314.16kHz.

4.3 POWER SUPPLY (DWG. NO. 1173-0309)

The power supply provides 3 regulated voltages; +5V, +15V, and -15V as well as 3 unregulated voltages; +5V, LED PWR, and LAMP POWER. A dual-primary transformer allows operation at a live voltage of 115 or 230 volts and is selectable from the rear panel by switch S-2. The power regulator transistors are mounted on the rear panel which serves as a heat sink. The regulation function and current limiting function are performed by the uA723 regulators. The+5V supply uses the +15V supply as a reference and therefore will only function when the +15V supply is operative.

4.4 DISPLAY AND CONTROLS (DWG. NO. 1174-0300)

The Display and Control functions are performed by BCD switches S1 through S5 logically wire-ored to a bus line using open collector logic to the phase lock ÷N counters. The bus line is remoted by inhibiting the BCD switch signals to the bus. Test Point E3 is the line which inhibits the BCD switch signals when a logical 0 (low) is presented. The bus is also tied to BCD decoders and seven-segment LED readouts. Thus the LED readouts show the state of the bus. S6 and associated circuitry operate in a similar manner for rangeing. Range 1 corresponds to the MHz or highest range, while Range 5 corresponds to the lowest range. J1 and J2 interconnect the bus by means of flat cables to the ÷N counters in the phase locked loops. This bus may also be connected to the circuit board providing programming options.

4.5 DIVIDE-BY-N COUNTERS (DWG NO's 1174-0302 and 1173-0304)

The Main Loop and the Vernier Loop divide-by-N counters operate in a similar fashion. U502, U503, U504 are operated as programmable down counters. U501 is a programmable up counter. U509 takes the 9's complement of the BCD input digit in order to properly program the up counter. U301, U302, U303 and U304 are four input multiplexers which provide the addition function by alternately loading the appropriate digits. This function is only generated in the Main loop.

U311 and U309 provide a look-ahead function for high-speed counting. E4 and E19 are test points showing the output of the divide-by-N counters. When the loops are locked the output frequencies of E4 and E19 should be 10kHz and 9.9kHz respectively.

4.6 SAMPLE AND HOLD CIRCUITS (DWG. NO's 1173-0305 and 1173-0305)

The Main Loop and the Vernier Loop Sample and Hold Circuits operate in a similar fashion. The Sample and Hold Circuits are used as phase detectors in the phase-locked loops. Q403 generates a ramp voltage in synchronism with the 10kHz reference. (E25) the ramp is sampled by U404 and held on capacitor C415. The voltage on C415 is sampled at a later time and held on C416. The samples are taken in synchronism with the outputs of the divide by N counters and therefore produce a low ripple voltage proportional to the phase difference between the reference and the output of the divide by N counters. U401, U402, and U403 generate the sample pulses for the Main Loop. U405 buffers the dc voltage and drives the input to the Voltage Controlled Oscillator.

4.7 VOLTAGE CONTROLLED OSCILLATORS (DWG. NO's 1173-0307 and 1173-0308)

The Main Loop and the Vernier Loop Voltage Controlled Oscillators operate in a similar fashion. U801 forms the basic oscillator with L802 and C803 forming the tank circuit. CR801 and CR802 are varicaps which provide voltage control of the frequency. Q801, Q802 in conjunction with U802, buffer the output of the oscillator and route the signal to the ÷N counters and the Mixer or range dividers. C801 and L801 form a notch filter to remove remnants of the sample frequency. Test Point E11 shows the DC control voltage applied to the varicaps.
The Vernier VCO covers a relatively narrow range of frequencies, 19.8MHz to 20.7801MHz, and therefore requires only one varicap. The Main VCO, however, covers a wide frequency range of 19.8 to 33.78MHz and therefore requires two varicaps as well as additional programming voltages to help acquire lock. CR803 and CR804 provide a non-linear filter for the dc program voltage.

4.8 PROGRAM VOLTAGE (DWG. NO. 1173-0301)

This circuitry develops a dc voltage to aid the Main Loop VCO in acquiring lock. U202 and U204 with associated circuitry form a D-A converter. Test Point E12 shows the program voltage. The digital information driving the D-A converter is taken directly from the bus line described in Section 4.4. 1/2 U205 in conjunction with C210, R229 and R227 form a precision low-ripple power supply for the weighting resistors in the D-A converter.

4.9 CLOCK GENERATOR (DWG. NO. 1173-0306)

The Clock Generator derives the 10kHz and 9.9kHz reference frequencies from the main 3.96MHz crystal reference oscillator. Test Point E14 shows the 3.96MHz reference frequency which is generated by either the standard oscillator or a high stability TCXO for Option 004. The standard oscillator frequency is adjusted by C703. The 10kHz reference is generated by dividing by 396 while the 9.9kHz reference is generated by dividing by 400. E13 and E22 show the 10kHz and 9.9kHz reference frequencies respectively.

4.10 RANGE DIVIDERS AND MIXER (DWG. NO. 1174-0350)

U305, U306 and U307 divide the Vernier Loop frequency in decade steps. The divided frequencies can be seen at Test Points E5, E7, and E8. The dividers are controlled so that for a particular range, the unused dividers are inhibited. U301, U302, U303, and U304 select the signal dependent on range and steer it to the bandpass filters. The outputs of the bandpass filters are summed. Test point E14 shows the summed signal. Since only one bandpass filter is fed at any one time, the summed output is actually the output of the selected bandpass filter. This signal is the rf signal to the mixer and has low harmonic content due to the bandpass filtering. The level of the rf signal is controlled by the dc voltage applied to the pull-up resistors driving the bandpass filters. This dc voltage is driven by Q301 which derives the voltage from an a g c signal formed in the output amplifier. U308, U309 and U310 divide the Main Loop frequency in decade steps and thus derive the LO signal for the mixer. U311 selects the desired frequency dependent on range while U312 drives the LO port of the mixer through a matching network. Test point E13 shows the LO frequency. The IF port of the mixer is coupled through a preamplifier to a set of low pass filters. The low pass filter is selected dependent on range by relays K201, K202, K203 and K204. The purpose of the low pass filters is to remove the sum frequencies and LO leakthrough. The filtered output is then routed to the amplifier.

4.11 OUTPUT SECTION

Q101, Q102, Q103 and Q104 form a preamplifier with feedback provided by R109. Q105 and Q106 form a differential input stage for the output power amplifier. Q107 derives the differential signal to drive Q108 and Q109 a complementary emitter coupled stage which drives the final stage formed by Q110 and Q111. R127 and R127A form the feedback network for the output amplifier. R139 provides the 50 ohm output impedance. U101 measures the dc output voltage and feeds back a correction signal

to the mixer preamplifier to eliminate output dc offset. U102 measures the output signal in conjunction with CR106 and CR107 and provides a g c correction to Q301 at the range dividers. K101 removes the a g c action in Range 5 (0.1Hz to 999.9Hz) R158 is the front panel LEVEL adjustment while M101 is the front panel meter. The attenuator between J101 and J102 provides attenuation in 10dB steps. The square wave output at J602 is derived from the output of the power amplifier by buffer Q601 waveshaper U601 and driver U602. U602 is a T^2L driver gate which can be terminated in 50 ohms.

4.12 REMOTE PROGRAMMING (OPTION 001) (DWG. NO. 1174-0372)

U1, U3, U6, U8, U11, and U13 form a bank of D type flip flops used as storage registers for the programming data. These data are strobed into the registers by U17 and U19 for frequency programming and U22 for amplitude programming. Ready signals are returned after a time delay to permit stabilization of the programmed parameter. The data accepted on J5 must be presented as negative true; i.e. low corresponds to true.

Operation and timing is further described in Section 3.

SECTION 5
MAINTENANCE

5.1 INTRODUCTION

This section provides information for testing, calibration, and troubleshooting of the Model 1013 Frequency Synthesizer. The performance test is designed for incoming inspection and periodic evaluation. If performance is not to specifications, refer to the calibration and troubleshooting sections.

5.2 SERVICE INFORMATION

5.2.1 DISASSEMBLY INFORMATION

Removal of Top Cover

A - Turn off power

B - Remove the three screws located on the upper edge of the rear panel that secure the top cover. Slide the top cover toward the rear of the unit to remove it.

Removal of Bottom Cover

A - Turn off power

B - Remove the three screws located at the bottom edge of the rear panel that secure the bottom cover. Slide the bottom cover toward the rear of the unit to remove it.

Removal of Power Supply Board (Assembly 3)

A - Turn off power

B - Unplug all the connectors going to the printed circuit board. Using the A3 Assembly Drawing, record the color and position of all wires soldered to the board. Unsolder the connecting wires. Remove the screws securing the board. Remove the board.

Removal of the Display and Controls Board

(Front Panel Mounted, Assembly A 4)

A - Turn off power

B - Remove all the front panel knobs from the Frequency and Range selector controls.

C - Unplug the edge connector from the upper edge of the board.

D - Remove the bushing nuts from the Frequency and Range selector controls (not all controls have bushing nuts). Exercise caution to prevent scratching the panel.

E - Move the board backward and upwards to gain access to the ribbon connectos. Unplug the ribbon connectors and remove the board.

Removal of the Frequency Generation Board

(Top Horizontal Board, Assembly A 1)

A - Turn off power

B - Unplug the two ribbon connectors and the power connector.

C - Disconnect the two signal outputs located at the front edge of the board.

D - Remove the screws securing the oscillator covers.

E - Remove both oscillator covers.

F - Remove all the screws securing the board to the chassis.

G - Remove the board.

Removal of the Range and Output Board

(Bottom Horizontal Board, Assembly A 2)

A - Turn off power

B - Unplug both output signal connectors.

C - Unplug the three six pin connectors carrying power and control signals.

D - Remove the two snap-on signal input connectors by pulling them vertically away from the board.

E - Remove all the screws securing the board to the chassis.

F - Remove the board.

5.2.2 SERVICE FOR PANEL LAMPS

The three panel lamps are wired in a series circuit. When the panel lamps do not illuminate, the defective lamp must be determined either by substitution or by using an ohmmeter. Lamp replacement is GE 1767.

5.2.3 ASSEMBLY

When reassembling the unit, correct operation may not be obtained unless all the board mounting screws are secure. The screws located on the rear panel that secure the power supply board standoffs should also be checked for security. The oscillator covers are held down by screws which are shorter than the board mounting screws. When replacing the ribbon connectors, be sure that they are correctly polarized.

When replacing top and bottom covers, be sure that they slide into the horizontal groves located on back of the front panel.

5.3 PERFORMANCE CHECKS

5.3.1 INDICATOR CHECKS

A - Set the Frequency Selector to 8.8888MHz.Check to see that all LED segments are illuminated. Set the Frequency Selector to 10.0000MHz as a check on overange LED.

B - Rotate the range switch through all ranges. Check that the range annunciator LEDS are illuminated.

5.3.2 FREQUENCY ACCURACY

Set the output frequency to 1MHz. Check the output frequency with an accurate counter. The maximum permissible deviation is .001% of 1MHz or 10Hz.

5.3.3 FREQUENCY CONTROLS

A - Connect an accurate frequency counter to the output.

B - Set the range selector to MHz.

C - Cycle each frequency selector digit through all its positions to ensure correct programming.

5.3.4 RANGE CONTROLS

A - Connect a counter to the output.

B - Set the frequency to 900Hz

C - Rotate the range selector switch through each frequency range to ensure correct operation of the range commands and divider circuitry.

5.3.5 OUTPUT LEVEL CONTROL

A - Rotate the Level Control full counter-clockwise. The output meter should indicate less than -10dBm.

B - Rotate the Level Control clockwise. The output meter should read above full scale.

C - Rotate the Level Control to obtain a reading of 0dBm.

5.3.6 OUTPUT METER

A - Terminate the output in a precision 50 ohm termination.

B - Set the output frequency to 1MHz.

C - Set the output attenuator to 1 volt.

D - Connect an accurate AC Digital Voltmeter to the terminated output.

E - Adjust the Level Control to obtain an indicated output of 1 volt.

F - Check the level of the actual output indicated on the Digital Voltmeter

5.3.7 OUTPUT ATTENUATOR

A - Set the frequency to 1MHz

B - Connect a Precision 50 ohm 10dB step attenuator to the output.

C - Terminate the external step attenuator with a precision 50 ohm termination.

D - Monitor the output with a Spectrum Analyzer, or Voltmeter. (If the analyzer or voltmeter have 50 ohm input, do not use the termination)

E - Adjust the Model 1013 output attenuator to 20dB. Set the output meter to 0dB.

F - Adjust the external pad to 40dB of attenuation.

G - Record the reference level obtained on the external indicator (Spectrum analyzer or voltmeter)

H - Increase the attenuation of the Model 1013 by one 10dB step. Decrease the attenuation of the external pad to 30dB.

I - Observe the level change on the external indicator.

J - Repeat steps G and H until all attenuation steps of the Model 1013 have been checked.

5.3.8 HARMONIC DISTORTION

A - Set the output attenuator to 1 volt.

B - Set the output level to 1 volt.

C - Set the output frequency to 1MHz.

D - Connect the output to a spectrum analyzer.

E - All harmonic signals should be 50dB below the fundamental.

F - Change the output frequency from 1MHz to 12MHz while monitoring the spectrum analyzer. All harmonic signals should be 40dB below the fundamental.

5.3.9 SPURIOUS

A - Set the output attenuator to 1 volt.

B - Set the output meter to 0dBm.

C - Set the frequency to 1MHz.

D - Connect the output to a spectrum analyzer.

E - Observe the analyzer to ensure that all non-harmonically related spurious are at least 60dB below the fundamental.

F - Change the output frequency from 1MHz to 12MHz while monitoring the spectrum analyzer to ensure that all spurious are within the specifications.

5.3.10 LEVELING

A - Set the output attenuator to 1 volt.

B - Set the output meter to 0 dB.

C - Set the frequency to 1MHz.

D - Connect the output to Precision R.F. Voltmeter.

E - Record the output level.

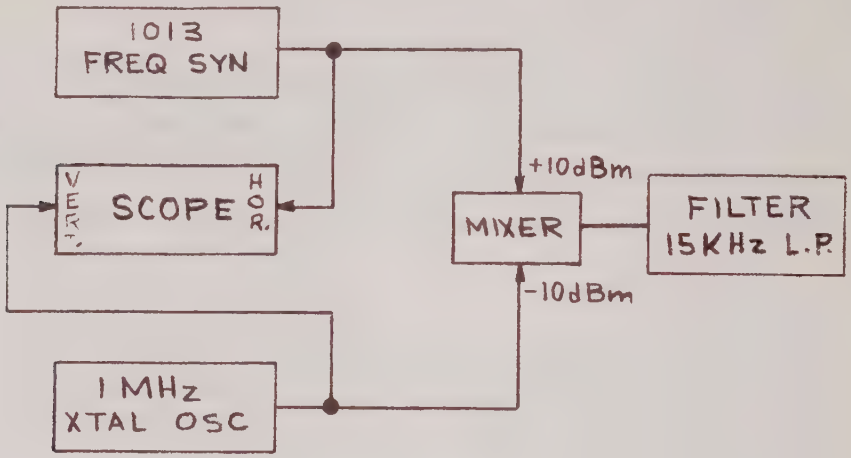
F - Change the output frequency from 1MHz to 12MHz while monitoring the R.F. Voltmeter. The permissible deviation is ±.25dB.

5.3.11 PHASE NOISE

This check uses an external 1MHz crystal oscillator as a reference frequency. The output of the Model 1013 and the 1MHz oscillator are mixed and the difference frequency is filtered and applied to an AC Voltmeter. When a small frequency difference exists between the Model 1013 output and the crystal oscillator, the

phase of the mixer output signal will drift slightly as the mixer output signal drifts through phase quadrature, the AC voltmeter will peak. This peak value is the maximum phase noise.

A - Connect the equipment as indicated below:



B - Set the synthesizer range selector to MHz.

C - Set the output frequency to 1MHz.

D - Set the output level to +10dBm.

E - Connect the synthesizer to the mixer L.O. port and the oscilloscope input.

F - Adjust the scope to obtain 1MHz 1 to 1 Lissajous pattern.

G - Set the Model 1013 output frequency to 1.0010MHz.

H - The level obtained on the voltmeter is the 0 reference level.

I - Set the 1013 output frequency back to 1MHz.

J - Adjust the frequency vernier of 1MHz crystal oscillator until a very slow rotation of the Lissajous pattern is obtained.

K - The peak reading on the voltmeter should be 40dB below the 0dB reference level obtained in step H.

5.3.12 SQUARE WAVE OUTPUT

A - Connect the square wave output to an oscilloscope with a 50 ohm termination at the scope input.

B - Set the output meter to indicate 0dB.

C - Set the output frequency to 1MHz.

D - Observe the square wave on the oscilloscope.

E - NOTE: The input capacitance of many oscilloscopes will cause a reflection in the connecting cable. This problem may be circumvented by placing a 10dB pad directly before the 50 ohm cable termination.

5.4 CALIBRATION PROCEDURE

Remove top and bottom cover. Allow a fifteen minute warm-up period before calibrating. In general, calibration must be performed in the sequence given.

5.4.1 +15 VOLT ADJUSTMENT (POWER SUPPLY BOARD, ASSEMBLY A 3)

A - Connect a digital voltmeter to J3 Pin 2. Adjust R7 to produce +15 volts.

5.4.2 -15 VOLT ADJUSTMENT (POWER SUPPLY BOARD, ASSEMBLY A 3)

A - Connect a digital voltmeter to J3 Pin 3. Adjust R10 to produce -15 volts.

5.4.3 +5 VOLT ADJUSTMENT (POWER SUPPLY BOARD, ASSEMBLY A 3)

A - Connect a digital voltmeter to J4 Pin 1. Adjust R14 to produce +5 volts.

5.4.4 CRYSTAL FREQUENCY ADJUSTMENT (FREQUENCY GENERATION BOARD, ASSEMBLY A1)

A - Set the output frequency to 1MHz.

B - Connect a frequency counter with a precision time base to the output.

C - Adjust C703 to obtain an output frequency of 1MHz.

5.4.5 PROGRAM VOLTAGE ADJUSTMENT (FREQUENCY GENERATION BOARD, ASSEMBLY A 1)

A - Set the output frequency to 12.0000MHz.

B - Connect a digital voltmeter to E12.

C - Adjust R226 to obtain -10 volts.

5.4.6 LEVEL CALIBRATION (RANGE AND OUTPUT BOARD, ASSEMBLY A 2)

A - To avoid position sensitivity of the output meter, all level calibrations should be performed with the unit in a top up horizontal position.

B - Turn the power off. Zero the output meter through the adjustment hole provided in the front panel. Turn the power back on.

C - Set the output frequency to 900Hz.

D - Set the output attenuator to 1 volt.

E - Terminate the output with a precision 50 ohm termination and connect it to an AC digital voltmeter.

F - Adjust the output level control (front panel) to obtain an indicated output level of one volt on the digital voltmeter.

G - Adjust R156 to produce a 1 volt read on the Model 1013 output meter.

H - Repeat steps F and G to obtain the desired result, i.e. a 1 volt reading on the Model 1013 output meter and a 1 volt reading on the digital voltmeter.

I - Set the output frequency to 1.9000KHz. Set the front panel level control to 1 volt indicated on the output meter of the 1013. Adjust R151 to obtain an output of 1 volt on the digital voltmeter.

5.5 TROUBLESHOOTING

Before troubleshooting the 1013, become familiar with the principals of operation. All significant waveforms are connected to test pins "E" designations; these are shown on both the schematics and assembly drawings. The waveforms are shown in the table of Test point waveforms.

Troubleshooting is accomplished by localizing the trouble to a P.C. board, then to a circuit function, and finally to the circuit element.

BOARD TEST SEQUENCE

1. Power Supply
2. Display and Controls
3. Frequency Generation
4. Range and Output

I - POWER SUPPLY BOARD (REAR PANEL MOUNTED)

The power supplies have over current protection; a short circuit will therefore cause a power supply to read low. Unplugging the connectors from the power supply eliminates this possibility. The +5 volt supply uses the +15 volt supply as a reference and therefore will only function when the +15 volt supply is operative.

Power Supply Troubleshooting Sequence:

1. +15 volt supply
2. -15 volt supply
3. +5 volt supply

Schematic
Power Supply 1173-0309

Assembly A 3
1944 - 0337

II - DISPLAY AND CONTROLS (FRONT PANEL MOUNTED)

An automatic test feature is provided. By shorting test point E_1 to ground, (E_2) the indication 1 8 8 8 8 8 and all decimal points plus the all range indicators should light.

By shorting Test point E_3 to ground, the remote condition is tested. Proper indication is a blank display except for a leading "1". 1 bl bl bl bl bl.

These two tests are a 95% self check of the Display and Controls board. Should the display give an incorrect indication, the defective component can generally be traced through the schematic.

Schematic	Assembly A 4
Display and Controls 1174-0300	1944 - 0328

III - FREQUENCY GENERATION BOARD (TOP HORIZONTAL BOARD)

The Frequency Generation Board contains three major circuit functions. The clock generator, the vernier phase locked loop, and the main phase locked loop.

Function Test Sequence

1. Clock Generator
   - A. Crystal Oscillator
   - B. 9.9kHz Dividers
   - C. 10kHz Dividers

2. Vernier Phase Locked Loop
   - A. Vernier VCO
   - B. Vernier divide by N
   - C. Vernier sample and hold

3. Main Phase Locked Loop
   - A. Loop programmer
   - B. Main VCO
   - C. Main divide by N
   - D. Main sample and hold

Schematic		Assembly A 1
Clock Generator	1173-0306	1944 - 0327
Vernier VCO	1173-0308	
Vernier Divide By N	1173-0304	
Vernier Sample and Hold	1173-0305	
Program Voltage	1173-0301	
Main VCO	1173-0307	
Main Divide by N	1174-0302	
Main Sample and Hold	1173-0305	

IV - RANGE AND OUTPUT BOARD (BOTTOM HORIZONTAL BOARD)

The range and output board contains the decimal range dividers and associated filters, mixer, output amplifier, and detector, and the square wave generator. The output amplifier D.C. level is maintained at zero DC by a feed back circuit with a multi-second time constant. All the filters are factory adjusted and glyptoled and should not be touched.

Troubleshooting Sequence

1. Main range divider
2. Vernier range divider
3. Mixer amplifier
4. Output amplifier
5. Square wave generator

Schematics		Assembly A 2
Range Dividers and Mixer	1174-0350	1944 - 0348
Output Section	1174-0382	

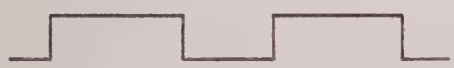
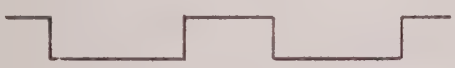
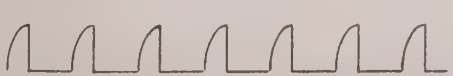
Set Frequency to MHz range frequency 10.0000

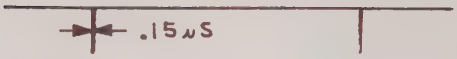
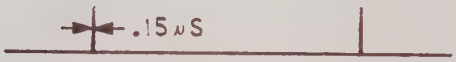
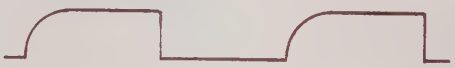
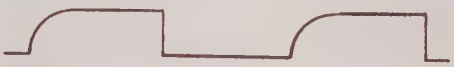
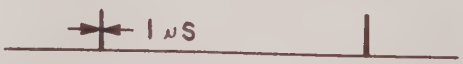
Set Amplitude to 0dBm

FRONT BOARD (1944-0328)

E1	Lamp test	Short to E2, the display showing 18.8.8.8.8	MHz kHz Hz
E2	Ground		
E3	Remote test	Short to E2, all display blank out except the MSD (most significant digit) is "1"	

TOP BOARD (1944-0327)

E1	Multiplex signal		10kHz
E2	Main divider Load signal		20kHz
E3	$\overline{E1}$		10kHz
E4	Main divider Output		10kHz
E5	Sampling delay		10kHz
E6	First sampling signal		10kHz
E7	Second sampling signal		10kHz
E10	Main VCO control voltage	DC 1 - 8 V	
E11	Main VCO tank (under VCO cover)		29.80MHz
E12	Program voltage	DC -10 V	
E13	Reference clock 1		10kHz
E14	Time base		3.960MHz

E15	+Vcc	DC 5 V	
E16	Ground		
E17	Vernier divide load signal		9.9kHz
E18	Sampling delay		9.9kHz
E19	Vernier divider output		9.9kHz
E20	Second sampling signal		9.9kHz
E21	Ramp signal 2		9.9kHz
E22	Reference check 2		9.9kHz
E23	Vernier VCO control voltage	DC 1 - 8 V	
E24	Vernier VCO tank		19.80MHz
E25	Ramp signal 1		10kHz
E26	Ground		
E27	Main VCO output 1		29.80MHz
E28	First Sampling Signal		9.9KHz
E29	Main VCO output 2		29.80MHz
E30	Vernier VCO output 2		19.80MHz
E33	Ground		
E34	Vernier VCO output 1		19.80MHz

BOTTOM BOARD (1944-0348)

E1	13MHz LPF output		10MHz
E2	1.3MHz LPF output	DC 0 V	
E3	130kHz LPF output	DC 0 V	
E4	13kHz LPF output	DC 0 V	
E5	E6 ÷ 10	DC 0 V	
E6	Vernier VCO output		19.8MHz
E7	E5 ÷ 10	DC (either 5 V or 0 V)	
E8	E7 ÷ 10	DC (either 5 V or 0 V)	
E9	Main VCO output		29.80MHz
E10	E9 ÷ 10	DC (either 5 V or 0 V)	
E11	E10 ÷ 10	DC (either 5 V or 0 V)	
E12	E11 ÷ 10	DC(either 5 V or 0 V)	
E13	Main VCO output		29.8MHz
E14	Mixer LO input		29.8MHz
E15	Mixer output		10MHz

SECTION 6
SCHEMATICS AND PARTS LIST

6.1 INTRODUCTION –

This section contains all schematics and a list of replaceable parts.

6.2 SCHEMATIC NOTES — The following notes and abbreviations pertain to all schematics. Additional notes pertaining to specific schematics are included on each schematic if required.

Denotes Binding Post on Front Panel

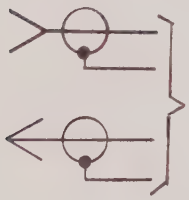
Denotes Operational Amplifier I.C.

✱ Denotes component value factory selected

E Test Point Designation

WE-310 3 Wire Phone Jack (Tip ring and Sleeve)

Arrow indicates rotation of wiper in clockwise direction



Denote RF connectors

6.3 ABBREVIATION CODE

A	ampere	IF	intermediate frequency	Ω	ohm
ac	alternating current	kHz	kiloherz	p-p	peak to peak
C	capacitor	Kohm	kilohm	pF	picofarad
CR	diode	kv	kilovolt	Q	transistor
dB	decibel	kW	kilowatt	R	resistor
dBm	decibel referred to 1mW	L	inductor	RF	radio frequency
dc	direct current	MHz	megahertz	rms	root-mean-square
DS	device indicating, lamp	Mohm	megohm	R.P.	rear panel
F	farad	uF	microfarad	S	switch
F.P.	front panel	uA	microampere	T	transformer
H	henry	uH	microhenry	V	volt
Har	harmonic	mA	milliampere	VA	voltampere
Hz	hertz	mH	millihenry	W	watt
U	integrated circuit	mV	millivolt	Y	crystal
		mW	milliwatt		

MANUFACTURERS' CODE - The following code is used on the parts list to identify the manufacturer.

A-B	Allen-Bradley	Milwaukee, Wisconsin
A-E	Arco-Elmenco	Great Neck, New York
AER	Aerovox	New Bedford, Massachusetts
ALC	Alco Electronic Products,Inc.	Lawrence, Massachusetts
AMP	AMP, Inc.	Harrisburg, Pennsylvania
AMR	Armour Electronics	Worcester, Massachusetts
APL	Amphenol	Danbury, Connecticut
APX	Amperex	Slatersville, Rhode Island
AUG	Augat	Attleboro, Massachusetts
AMD	Advance Micro Devices	Sunnyvale, California
BEK	Beckman Instruments, Inc.	Fullerton, California
BEL	Belden	Chicago, Illinois
BOU	Bourns	Riverside, California
BUS	Bussman	St.Louis, Missouri
CAM	Cambion	Cambridge, Massachusetts
C-D	Cornell Dubilier	Newark, New Jersey
CGW	Corning Glass Works	Corning, New York
C-J	Cinch Jones	Elk Grove Village,Illinois
C-L	Centralab	Milwaukee, Wisconsin
CTS	Chicago Telephone Systems	Elkhart, Indiana
C-W	Continental Wire	Philadelphia, Pennsylvania
DEL	Delevan	East Aurora, New York
DIO	Diodes, Inc.	Chatsworth, California
DRA	Drake Mfg. Company	Harwood Heights,Illinois
EDA	Edal Industries, Inc.	East Haven, Connecticut
ELEC	Elec-Trol	Saugus, California
ETP	Erie Technological Prod. Inc.	Erie, Pennsylvania
EMC	Electronic Molding Corp.	Woonsocket, Rhode Island
ELX	Elenex, Inc	Naples, New York
FCD	Fairchild	Mountain View, California
F-D	F. Dyne	Bridgeport, Connecticut
G-E	General Electric	Syracuse, New York
G-H	Grayhill	La Grange, Illinois
HHS	Herman H. Smith, Inc.	Brooklyn, New York
H-P	Hewlett-Packard	Palo Alto, California
HUD	Hudson Tool & Die	Newark, New Jersey
IRC	International Resistance Co.	Philadelphia, Pennsylvania
KEL	Kelvin Electric Co	Van Nuys, California
KEM	Kemet	Liverpool, New York

LEE	LEECRAFT	Long Island City, New York
LIT	Littelfuse	Des Plaines, Illinois
MAL	Mallory	Indianapolis, Indiana
MDC	Modutec	Norwalk, Connecticut
M-L	M.I.A.L	Nutley, New Jersey
M-O	Marko-Oak	Anaheim, California
MOT	Motorola	Phoenix, Arizona
MTO	Monsanto	Cupertino, California
MOL	Molex, Inc	Lisle, Illinois
N-S	National Semiconductor	Plattsburg, New York
NTK	MH&W International	Saddlebrook, New Jersey
P-B	Potter & Brumfield	Princeton, Indiana
PIH	Piher International Corp	Des Plaines, Indiana
Q-C	Quality Components	St. Marys, Pennsylvania
RCA	Radio Corporation of America	Harrison, New Jersey
RMC	Radio Material Company	Chicago, Illinois
SCC	Stackpole Carbon Co	St.Marys, Pennsylvania
SEG	Seg Electronics Corp	Richmond Hill, New York
SEL	Selectro	Mamaroneck, New York
SEM	Semtech	Newbury Park, California
SGM	Sangamo Electric Co	Pickens, South Carolina
SGY	Standard-Grigsby	Aurora, Illinois
S-I	Switchcraft, Inc	Chicago, Illinois
SIG	Signetics Corporation	Sunnydale, California
SPR	Sprague	N.Adams, Massachusetts
S-T	Sarkes Tarzian	Bloomington, Indiana
SYL	Sylvania	Woburn, Massachusetts
SOL	Solitron Devices	Tappan, New York
THR	Thermalloy Company	Dallas, Texas
T-I	Texas Instruments	Dallas, Texas
TRW	TRW Capacitor Division	Ogallala, Nebraska
WAL	Waldom Electronics, Inc	Chicago, Illinois
WEC	Weckesser Company, Inc	Chicago, Illinois

PARTS LIST

FREQUENCY GENERATION BOARD
ASSY A - 1 REV. ____

REFERENCE SYMBOL	DESCRIPTION	COMSTRON PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
C201, C203, C210, C211, C301, C305, C318, C319, C401, C414A, C414B, C418, C420, C501, C503, C601, C614A, C614B, C618, C620, C701, C716, C806, C808, C810, C814, C906, C908, C914	Capacitor, Tantalum 15 uF, 20 V		KEM	T368B156 M20AS	29
C202, C204, C206, C207, C208, C209, C302, C303, C304, C306, C307, C308, C309, C310, C311, C312, C313, C314, C315, C316, C317, C402, C405, C407, C409, C411, C413, C504, C505, C506, C507, C508, C509, C510, C511, C512, C513, C514, C602, C605, C607, C609, C611, C613, C702, C707, C708, C709, C710, C711, C712, C713, C714, C804, C805, C807, C811, C812, C813, C904, C905, C907, C911, C912, C913	Capacitor, Ceramic .01 uF, 100V		RMC	Type TA	65

PARTS LIST

FREQUENCY GENERATION BOARD
ASSY A-1

REV. ____

REFERENCE SYMBOL	DESCRIPTION	COMSTRON PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
C406, C408, C410, C412, C606, C608, C610, C612	Capacitor, Mica, 100 pF, 10%, 100 V		A - E	DM15DA101 FO	8
C415	Capacitor, Polycarbonate, .01 uF, 10%, 50V		F - D	PC12-.01-50-10	1
C416, C616	Capacitor, Mica, 2700 pF, 10%, 100V		A - E	DM19DA272 FO	2
C417, C617, C705, C803, C804, C816, C903, C917	Capacitor, Mica, 1000 pF, 5%, 100V		A - E	DM15DA102 JO	8
C419, C619	Capacitor, Mylar, 1uF, 10%, 50V		F - D	MPE 11-1.0-100-10	2
C421, C621	Capacitor, Gimmic, 1 pF		Q-C	Type MC	2
C615	Capacitor, Polycarbonate, .005 uF, 10%,50V		F - D	PC12-.005-50-10	1
C703	Capacitor, Trimmer, 2 - 8 pF		ERIE	538-002A-2.8	1
C704, C706	Capacitor, Mica, 47pF, 5%, 100V		A - E	DM-15DA470 JO	2
C801, C901	Capacitor, Mica, 2700pF, 5%, 100V		A - E	DM-19DA272 JO	2
C802, C902	Capacitor, Polycarbonate, .05uF, 10%, 50V		F - D	PC12-.05-50-10	2
C809, C909	Capacitor, Electrolytic, 220uF, 25V		NTK	25S, 220E	2
C815, C915	Capacitor, Tantalum, 2.2uF, 20V		SPR	198D225X 0025H1	2
C916	Capacitor, Mica, 36pF, 5%, 100V		A - E	DM-15DA360 JO	1
CR301, CR302 CR303, CR304 CR305, CR401 CR601, CR803 CR804	Diode, Silicon		MOT	IN914	9
CR801, CR802 CR901	Diode, Varactor		MOT	MV109	3
L301, L501 L802, L902 L904	Choke, R.F., 1uH		DEL	1641-102	5
L401, L601 L803, L903	Choke, R.F., 22uH		DEL	1641-223	4

PARTS LIST

FREQUENCY GENERATION BOARD
ASSY A - 1

REV. ____

REFERENCE SYMBOL	DESCRIPTION	COMSTRON PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
L801,L901	Inductor, Variable	1402-0351-5			2
R201	Resistor,Pack, 6.8K, 5%, 1/4 W		DALE	CDP-18-01-682K	1
R202	Resistor, Pack, 75K, 5%, 1/4 W		DALE	CSP-10E-01-753K	1
R203, R204 R217, R218	Resistor, Metal Film, 100K, 1%, 1/8 W		CGW	NC55-100K-1%	4
R205, R206	Resistor, Metal Film, 40.2K, 1%, 1/8 W		CGW	NC55-40.2K-1%	2
R207, R208	Resistor, Metal Film, 8.06K, 1%, 1/8 W		CGW	NC55-8.06K-1%	2
R209, R210	Resistor, Metal Film, 80.6K, 1%, 1/8 W		CGW	NC55-80.6K-1%	2
R211, R212 R213, R214	Resistor, Metal Film, 199K, 1%, 1/8 W		CGW	NC55-199K-1%	4
R215, R216	Resistor, Metal Film, 20K, 1%, 1/8 W		CGW	NC55-20K-1%	2
R219, R220	Resistor, Metal Film, 10K, 1%, 1/8 W		CGW	NC55-10K-1%	2
R221	Resistor, Composition, 750K, 5%, 1/4 W		A-B	CB7515	1
R222, R224 R708, R709 R807, R810 R907, R910	Reistor, Composition, 100 ohm, 5%, 1/4 W		A-B	CB1015	8
R223	Resistor, Composition, 11K, 5%, 1/4 W		A-B	CB1135	1
R225	Resistor, Composition, 220 ohm, 5%, 1/4 W		A-B	CB2215	1
R226	Resistor, Variable, Trimmer 5K		PIH	PT-10 V	1
R227, R228	Resistor, Composition, 10K, 5%, 1/4 W		A-B	CB1035	2
R229	Resistor, Composition, 20K, 5%, 1/4 W		A-B	CB2035	1
R230, R701	Resistor, Composition, 47K, 5%, 1/4 W		A-B	CB4735	2
R301, R302 R303, R304 R305, R306	Resistor Pack, 6.8K, 5%, 1/4 W		SOL	RN1L68ZDA	6
R307, R308 R309, R412 R413, R501 R502, R503 R612, R613	Resistor, Composition, 3.3K, 5%, 1/4 W		A-B	CB3325	10

PARTS LIST

FREQUENCY GENERATION BOARD
ASSY A - 1

REV. ____

REFERENCE SYMBOL	DESCRIPTION	COMSTRON PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
R401, R403 R404, R601 R603, R604	Resistor, Composition, 15K, 5%, 1/4 W		A-B	CB1535	6
R402, R405 R408, R602 R605, R608 R801, R802 R901, R902	Resistor, Composition, 2.2K, 5%, 1/4 W		A-B	CB2225	10
R406, R606	Resistor, Composition, 2.7K, 5%, 1/4 W		A-B	CB2725	2
R407, R607 R702	Resistor, Composition, 470 ohm, 5%, 1/4 W		A-B	CB4715	3
R409, R410 R609, R610 R803	Resistor, Composition, 2K, 5%, 1/4 W		A-B	CB2025	5
R411, R611 R704, R706	Resistor, Composition, 1K, 5%, 1/4 W		A-B	CB1025	4
R414, R614	Resistor, Composition, 9.1K, 5%, 1/4 W		A-B	CB9125	2
R703	Resistor, Composition, 200 ohm, 5%, 1/4 W		A-B	CB2015	1
R705	Resistor, Composition, 22K, 5%, 1/4 W		A-B	CB2235	1
R707	Resistor, Composition, 47 ohm, 5%, 1/4 W		A-B	CB4705	1
R804, R904	Resistor, Composition, 8.2K, 5%, 1/4 W		A-B	CB8225	2
R805, R905	Resistor, Composition, 27K, 5%, 1/4 W		A-B	CB2735	2
R806, R906	Resistor, Composition, 68 ohm, 5%, 1/4 W		A-B	CB6805	2
R808, R908	Resistor, Composition, 330 ohm, 5%, 1/4 W		A-B	CB3315	2
R809, R909	Resistor, Composition, 180 ohm, 5%, 1/4 W		A-B	CB1815	2
R811, R911	Resistor, Composition, 220 ohm, 5%, 1 W		A - B	CB2215	2
R903	Resistor, Composition, 3.9K, 5%, 1/4 W		A-B	CB3925	1

PARTS LIST

FREQUENCY GENERATION BOARD
ASSY A - 1

REV. ____

REFERENCE SYMBOL	DESCRIPTION	COMSTRON PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
Q201	Transistor, PNP		GE	2N 6011	1
Q202	Transistor, NPN		GE	2N 6010	1
Q401,Q402 Q403,Q601 Q602,Q603	Transistor, NPN		FCD	2N 4275	6
Q701,Q702	Transistor, NPN		MOT	MPS918	2
Q801,Q802 Q901,Q902	Transistor, PNP		MOT	2N3640	4
U201,U203	Integrated Circuit		SIG	N7404A	2
U202,U204	Integrated Circuit		RCA	CA3046	2
U205	Integrated Circuit		MOT	MC1458CP	1
U301,U302 U303,U304	Integrated Circuit		SIG	N74157B	4
U305,U306 U307,U502 U503,U504	Integrated Circuit		SIG	N74192	6
U308,U501	Integrated Circuit		FCD	74196	2
U309,U310 U505	Integrated Circuit		SIG	N74H103A	3
U311,U506	Integrated Circuit		SIG	N74H102A	2
U312	Integrated Circuit		SIG	N74H04A	1
U313,U508	Integrated Circuit		SIG	N7402A	2
U314,U509	Integrated Circuit		NS	DM74184N	2
U315	Integrated Circuit		SIG	N74H00A	1
U316,U510	Integrated Circuit		SIG	N74H11	2
U401,U402 U403,U601 U602,U603	Integrated Circuit		SIG	N74121A	6
U404,U604	Integrated Circuit		RCA	CD4016AE	2
U405,U605	Integrated Circuit		RCA	CA-3130	2

PARTS LIST

FREQUENCY GENERATION BOARD
ASSY A - 1

REV. ____

REFERENCE SYMBOL	DESCRIPTION	COMSTRON PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
U507	Integrated Circuit		SIG	N74502A	1
U511,U512	Integrated Circuit		MOT	MC14050CP	2
U701	Integrated Circuit		SIG	N74H21A	1
U702,U703 U704,U705	Integrated Circuit		SIG	N7490A	4
U706,U707	Integrated Circuit		SIG	N7473A	2
U801,U901	Integrated Circuit		MOT	MC1648P	2
U802,U902	Integrated Circuit		SIG	N74S00A	2
J1, J2	Connector, 14 pin		AUG	514-AG11D	2
J3	Connector, Power		MOL	09-18-5061	1
E1,E2,E3,E4, E5,E6,E7,E8, E9,E10,E11, E12,E13,E14, E15,E16,E17, E18,E19,E20, E21,E22,E23, E24,E25,E26, E27,E28,E29, E30,E31,E32, E32,E33,E34, E35,E36	Test Point		CAM	460-2970-02-03	36
W1	Cable Assembly - N	1752-0371-1			1
W2	Cable Assembly - N	1752-0371-2			1
Y701	Crystal 3.96MHz		ELX		1

PARTS LIST

RANGE AND OUTPUT BOARD
ASSY A - 2

REV. ____

REFERENCE SYMBOL	DESCRIPTION	COMSTRON PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
C191,C103, C104,C113, C114,C116, C118,C122, C123,C124, C126,C127, C128,C230, C301,C303, C305,C306, C402,C404, C407,C409, C410,C501, C508,C513, C518,C601, C602,C603, C604,C606, C320,C108, C110,C307, C308,C309, C311,C312, C313,C314, C315,C316, C317,C318, C319,C231	Capacitor, Ceramic, .01 uF, 100 V		RMC	Type TA	50
C102,C105, C115,C117, C119,C120, C121,C229, C320,C322, C325,C401, C403,C406, C408,C507, C512,C517, C605,C310, C304	Capacitor, Tantalum, 15uF, 20 V		KEM	T368B156 MO20AS	21
C125,C129	Capacitor, Tantalum, 2.2uF, 20 V		SPR	198D225X 0025HI	2
C106	Capacitor, Mica 20pF		A-E	DM15DA200 MO	1
C134	Capacitor, Mica, 140pF		A-E	DM15DA141 JO	1
C133	Capacitor, Mica, 39pF		A-E	DM15DA390 JO	1
C132	Capacitor, Mica, 180pF		A-E	DM150A181 JO	1
C323, C411	Capacitor, Mica, 47pF		A-E	DM15DA470 JO	2
C130,C135, C202	Capacitor, Mica, 5pF		A-E	DM15DA050 DO	3

PARTS LIST

RANGE AND OUTPUT BOARD ASSY A - 2

REV. ____

REFERENCE SYMBOL	DESCRIPTION	COMETRON PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
C109,C321	Capacitor, Mica, 150pF		A-E	DM15DA151 KO	2
C514	Capacitor, Mica, 33pF		A-E	DM15DA330 JO	1
C201	Capacitor, Mica, 56pF		A-E	DM15DA560 JO	1
C203	Capacitor, Mica, 101pF		A-E	DM15DA101 JO	1
C204	Capacitor, Mica, 22pF		A-E	DM15DA220 JO	1
C205	Capacitor, Mica, 91pF		A-E	DM15DA910 JO	1
C206,C131	Capacitor, Mica, 15pF		A-E	DM15DA150 JO	2
C207	Capacitor, Mica, 49pF		A-E	DM15DA490 JO	1
C208	Capacitor, Mica, 580pF		A-E	DM15DA581 JO	1
C209	Capacitor, Mica, 43pF		A-E	DM15DA430 JO	1
C210	Capacitor, Mica, 1000pF		A-E	DM15DA102 JO	1
C211	Capacitor, Mica, 200pF		A-E	DM15DA201 JO	1
C212	Capacitor, Mica, 910pF		A-E	DM15DA911 JO	1
C213	Capacitor, Mica, 150pF		A-El	DM15DA151 JO	1
C214	Capacitor, Mica, 500pF		A-E	DM15DA501 JO	1
C215	Capacitor, P.C., .0056uF		F-D	PC11-.0056-200-10	1
C216	Capacitor, Mica, 430pF		A-E	DM15DA431 JO	1
C217	Capacitor, P.C., .01uF		F-D	PC12-.01-50-10	1
C218	Capacitor, P.C., .002uF		F-D	PC11-.002-200-10	1
C219	Capacitor, P.C., .0091uF		F-D	PC11-.0091-200-10	1
C220	Capacitor, P.C., .0015uF		F-D	PC11-.0015-200-10	1
C221	Capacitor, P.C., .0047uF		F-D	PC11-.0047-200-10	1

PARTS LIST

RANGE AND OUTPUT BOARD
ASSY A - 2

REV. ____

REFERENCE SYMBOL	DESCRIPTION	COMSTRON PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
C222	Capacitor, Polycarbonate, .056uF		F-D	PC12-.056-50-10	1
C223	Capacitor, Polycarbonate, .0039uF		F-D	PC11-.0039-50-10	1
C224	Capacitor, Polycarbonate, .1uF		F-D	PC12-.10-50 10	1
C225	Capacitor, Polycarbonate, .02uF		F-D	PC12-.02-50 10	1
C226	Capacitor, Polycarbonate, .091uF		F-D	PC12-.091-50 10	1
C227	Capacitor, Polycarbonate, .015uF		F-D	PC12-.091-50-10	1
C228	Capacitor, Polycarbonate, .05uF		F-D	PC12-.05-50 10	1
C502,C504, C516,C509	Capacitor, Mica, 36pF		A-E	DM15DA360 JO	4
C503,C506	Capacitor, Mica, 390pF		A-E	DM15DA391 JO	2
C505	Capacitor, Mica, 360pF		A-E	DM15DA361 JO	1
C510,C511	Capacitor, Polycarbonate, 560pF		F-D	PC11-000560 200-10	2
C515,C516	Capacitor, Polycarbonate, 510pF		F-D	PC11-000510 200-10	2
C519	Capacitor, Mica, 820pF		A-E	DM15DA821 JO	1
C520,C521	Capacitor, Polycarbonate, .0076uF		F-D	PC11-0076-200-10	2
CR101,CR102 CR103,CR104, CR105,CR301 CR302,CR303 CR304,CR305 CR306,CR601 CR602	Diode, Signal			IN914	13
CR106,CR107	Diode, Hot Carrier		H-P	5082-2800	2
L101	Choke, 10uH		DEL	1641-103	1
L301	Choke, .1uH		DEL	1641-101	1
L103,L104 L601,L602	Choke, 22uH		DEL	1641-223	4
L302,L303	Choke, 1uH		DEL	1641-102	2

PARTS LIST

RANGE AND OUTPUT BOARD ASSY A - 2 REV. ____

REFERENCE SYMBOL	DESCRIPTION	COMSTRON PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
R118,R138, R115,R413	Resistor, 220 ohm, 1/2 W, 5%		A-B	EB 2215	4
R114,R102, R105, R415	Resistor, 470 ohm, 1/2 W, 5%		A-B	EB 4715	4
R123,R126	Resistor, 750 ohm, 1/2 W, 5%		A-B	EB 7515	2
R108,R103, R116,R159, R160,R304, R602	Resistor, 1K, 1/2 W, 5%		A-B	EB 1025	7
R112	Resistor, 2K, 1/2 W, 5%		A-B	EB 2025	1
R109	Resistor, 2.7K, 1/2 W, 5%		A-B	EB 2725	1
R127A	Resistor, 1.8K, 1/2 W, 5%		A-B	EB 1825	1
R141	Resistor, 2.4K, 1/2 W, 5%		A-B	EB 2425	1
R137	Resistor, 91K, 1/2 W, 5%		A-B	EB 9135	1
R156	Resistor, Variable, 1K		PIH	PT10V	1
R151	Resistor, Variable, 10K		PIH	PT10V	1
J301,J302	Jack, R.F., P.C. Mount		SEL	51-051-0000	2
J101,J601	Jack, R.C.A., P.C. Mount		WAL	15-24-0501	2
J1,J2,J3	Connector, P.C., 6 pin		MOL	09-18-5061	3
K101,K201, K202,K203, K204	Relay		ELEC	RA-3031-1051	5
XQ108	Socket, Transistor		EMC	7003-265-5	1
	Transistor Pad			7717-139	10
	Heatsink, T05		IERC	TXBF-032-025B	5
	Terminal, Pin		CAM	460-2970-02-03	16
A401	Mixer	1702-0369			1
U101,U102	Integrated Circuit		MOT	MC 1458CP	2
U311	Integrated Circuit		SIG	N 74S00A	1

PARTS LIST

RANGE AND OUTPUT BOARD ASSY A - 2 REV. ____

REFERENCE SYMBOL	DESCRIPTION	COMSTRON PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
L210	Inductor, Variable	1402-0351-1			1
L211	Inductor, Variable	1402-0351-2			1
L212	Inductor, Variable	1402-0351-3			1
L508,L509	Inductor, Variable	1402-0351-4			1
L102	Inductor, Variable	1403-0349-1			1
L201	Inductor, Variable	1403-0349-2			1
L202	Inductor, Variable	1403-0349-3			1
L203	Inductor, Variable	1403-0349-4			1
L204	Inductor, Variable	1403-0349-5			1
L205	Inductor, Variable	1403-0349-6			1
L206	Inductor, Variable	1403-0349-7			1
L207	Inductor, Variable	1403-0349-8			1
L208	Inductor, Variable	1403-0349-9			1
L209	Inductor, Variable	1403-0349-10			1
L501,L502 L503	Inductor, Variable	1403-0349-11			3
L504	Inductor, Variable	1403-0349-12			1
L505	Inductor, Variable	1403-0349-13			1
L506	Inductor, Variable	1403-0349-14			1
L507	Inductor, Variable	1403-0349-15			1
Q101,Q102, Q105,Q106, Q401,Q402	Transistor, NPN		MOT	2N5179	6
Q104,Q108, Q404	Transistor, NPN		MOT	2N5109	3
Q110	Transistor, NPN		MOT	2N3553	1
Q103,Q107, Q109,Q111, Q403	Transistor, PNP		MOT	2N5160	4

PARTS LIST

RANGE AND OUTPUT BOARD ASSY A - 2 REV. ____

REFERENCE SYMBOL	DESCRIPTION	COMETRON PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
Q601	Transistor, PNP		MOT	2N3640	1
Q301	Transistor, NPN		MOT	2N6010	1
R406,R407, R144,R142, R307	Resistor, 10 ohm, 1/4 W, 5%		A-B	CB 1005	5
R601,R605, R314,R506	Resistor, 18 ohm, 1/4 W, 5%		A-B	CB 1805	4
R402,R409	Resistor, 22 ohm, 1/4 W, 5%		A-B	CB 2205	2
R306,R313, R320,R401	Resistor, 47 ohm, 1/4 W, 5%		A-B	CB 4705	4
R410,R412, R607,R405	Resistor, 68 ohm, 1/4 W, 5%		A-B	CB 6805	4
R609,R327	Resistor, 100 ohm, 1/4 W, 5%		A-B	CB 1015	2
R308,R315, R322,R329, R501,R502, R503	Resistor, 150 ohm, 1/4 W, 5%		A-B	CB 1515	7
R154,R504	Resistor, 180 ohm, 1/4 W, 5%		A-B	CB 1815	2
R303,R305, R311,R312, R318,R319, R325,R326, R201,R202, R203,R204	Resistor, 200 ohm, 1/4 W, 5%		A-B	CB 2015	12
R404,R418, R328,R330	Resistor, 220 ohm, 1/4 W, 5%		A-B	CB 2215	4
R603	Resistor, 270 ohm, 1/4 W, 5%		A-B	CB 2715	1
R321,R505, R507	Resistor, 300 ohm, 1/4 W, 5%		A-B	CB 3015	3
R403	Resistor, 470 ohm, 1/4 W, 5%		A-B	CB 4715	1
R332	Resistor, 360 ohm, 1/4 W, 5%		A-B	CB 3615	1
R411	Resistor, 680 ohm, 1/4 W, 5%		A-B	CB 6815	1
R408	Resistor, 1K , 1/4 W, 5%		A-B	CB 1025	1

PARTS LIST

RANGE AND OUTPUT BOARD ASSY A - 2 REV. ____

REFERENCE SYMBOL	DESCRIPTION	COMSTRON PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
R157	Resistor, 1.1K, 1/4 W, 5%		A-B	CB 1125	1
R414	Resistor, 1.5K, 1/4 W, 5%		A-B	CB 1525	1
R608	Resistor, 1.6K, 1/4 W, 5%		A-B	CB 1625	1
R301,R302, R309,R310, R316,R317, R323,R324	Resistor, 2K, 1/4 W, 5%		A-B	CB 2025	8
R331,R416, R417	Resistor, 2.2K, 1/4 W, 5%		A-B	CB 2225	3
R155,R606	Resistor, 2.7K, 1/4 W, 5%		A-B	CB 2725	2
R152	Resistor, 4.7K, 1/4 W, 5%		A-B	CB 4725	1
R143,R147, R148,R161	Resistor, 10K, 1/4 W, 5%		A-B	CB 1035	4
R333	Resistor, 47K, 1/4 W, 5%		A-B	CB 4735	1
R150	Resistor, 82K, 1/4 W, 5%		A-B	CB 8235	1
R145	Resistor, 91K, 1/4 W, 5%		A-B	CB 9135	1
R146,R153	Resistor, 100K, 1/4 W, 5%		A-B	CB 1045	2
R133,R134, R135,R136	Resistor, 10 ohm, 1/2 W, 5%		A-B	EB 1005	4
R106,R107, R120,R121	Resistor, 15 ohm, 1/2 W, 5%		A-B	EB 1505	4
R113,R122	Resistor, 22 ohm, 1/2 W, 5%		A-B	EB 2205	2
R130	Resistor, 27 ohm, 1/2 W, 5%		A-B	EB 2705	1
R117,R110, R124,R139	Resistor, 47 ohm, 1/2 W, 5%		A-B	EB 4705	4
R104,R111, R119,R125, R128,R129, R131,R132	Resistor, 68 ohm, 1/2 W, 5%		A-B	EB 6805	8
R141,R604	Resistor, 100 ohm, 1/2 W, 5%		A-B	EB 1015	2
R101,R127	Resistor, 200 ohm, 1/2 W, 5%		A-B	EB 2015	2

PARTS LIST

RANGE AND OUTPUT BOARD ASSY A-2 REV. ____

REFERENCE SYMBOL	DESCRIPTION	COMSTRON PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
U301,U302, U303,U304	Integrated Circuit		N-S	DM74S03N	4
U201	Integrated Circuit		SIG	N7405A	1
U601	Integrated Circuit		SIG	N7413A	1
U602	Integrated Circuit		SIG	N7440AH	1
U306,U307, U309,U310	Integrated Circuit		SIG	N7490A	4
U312	Integrated Circuit		FCD	74S140	1
U305,U308	Integrated Circuit		FCD	74196	2

PARTS LIST

POWER SUPPLY BOARD
ASSY A - 3

REV. ____

REFERENCE SYMBOL	DESCRIPTION	COMTRON PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
C3,C4	Capacitor, Electrolytic, 2200 uF, 25 V		SPR	601D228G -025 HS4	2
C5	Capacitor, Mica, 100pF, 5%, 100V		A - E	DM15DA101 JO	1
C6	Capacitor, Mica, 560 pF		A - E	DM15DA561 KO	1
C7,C8,C9,C10 C12,C13,C17, C18,C19	Capacitor, Tantalum, 15uF, 20 V		KEM	T368B156 M020 A S	9
C11A, C11B	Capacitor, Electrolytic, 7500uF, 10 V		SPR	601D758G- 010JS4	2
C14	Capacitor, Mica, 270pF, 10%, 100V		A - E	DM15DA271 KO	1
C16	Capacitor, Ceramic, .01uF, 100V		RMC	Type TA	1
C20	Capacitor, Electrolytic, 220uF, 25 V		NTK	25S220E	1
CR1,CR8 CR9,CR10 CR11,CR12 CR13,CR14	Diode, Rectifier 1 Amp		MOT	IN4002	8
CR2,CR3 CR4,CR5	Diode, Rectifier, 4 Amp		EDA	MR4A5	4
R1	Resistor, Composition, 680 ohm, 5%, 1/2 W		A-B	EB6815	1
R2,R5	Resistor, Composition, 1 ohm, 5%, 1/2 W		A-B	EB10G5	2
R3,R4	Resistor, Composition, 3K, 5%, 1/4 W		A-B	CB 3025	2
R6,R15	Resistor, Composition, 2.2K, 5%, 1/4 W		A-B	CB 2225	2
R7,R10,R14	Resistor, Variable, Trimmer, 1K		PIH	PT-10-H	3
R8	Resistor, Composition, 1.8K, 5%, 1/4 W		A-B	CB 1825	1
R9	Resistor, Composition, 9.1K, 5%, 1/4 W		A-B	CB 9125	1
R11	Resistor, Composition, 2.7K, 5%, 1/4 W		A-B	CB 2725	1
R12	Resistor, Composition, 68 ohm, 5%, 1/4 W		A-B	CB 6805	1
R13	Resistor, Composition, 470 ohm, 5%, 1/4 W		A-B	CB 4715	1
R16	Resistor, Wirewound, .1 ohm, 5%, 3 W		KEL	Type KM-300	1
R18	Resistor, Composition, 6.8 ohm, 5%, 1/4 W		A-B	CB 6865	1

PARTS LIST

POWER SUPPLY BOARD
ASSY A - 3

REV. ____

REFERENCE SYMBOL	DESCRIPTION	COMSTRON PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
R19	Resistor, Composition, 1K, 5%, 1/4 W		A-B	CB 1025	1
Q3	Transistor, PNP		MOT	2N5087	1
U1,U2,U3	Integrated Circuit		SIG	uA 723 CA	3
J1, J2	Connector, 6 pin		MOL	09-185061	2
J3,J4,J5,J6	Connector, 3 pin		MOL	09-18-5031	4
					1

PARTS LIST

DISPLAY AND CONTROL BOARD
ASSY A - 4

REV. ____

REFERENCE SYMBOL	DESCRIPTION	COMSTRON PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
C1,C3,C4	Capacitor, Ceramic .01uF, 100V		RMC	Type TA	3
C2	Capacitor, Tantalum 15uF, 20 V		KEM	T368B156 M20AS	1
CR1,CR2 CR3,CR4 CR5,CR6 CR7,CR8	Diode, Silicon		MOT	IN914	8
DCR1,DCR2 DCR3,DCR4 DCR5,DCR6	LED Display, 7 Segment		HP	5 082-7730	6
DCR7,DCR8 DCR9,DCR10 DCR11,DCR12 DCR13	Diode, Light Emitting		MON	MV-5153	7
R1,R2,R3,R4 R5	Resistor Pack, 470 ohm, 5%, 1/4 W		A-B	34B4714	5
R6,R7,R8 R9,R10,R11	Resistor Pack, 6.8K, 5%, 1/4 W		SOL	RNIL682 DA	6
R12,R13,R14 R15,R16,R17 R23	Resistor, Composition, 470 ohm, 5%, 1/4 W		A-B	CB 4715	7
R18,R19,R20 R24,R25,R26	Resistor, Composition, 220 ohm, 5%, 1/4 W		A-B	CB 2215	6
R21,R22	Resistor, Composition, 6.8K, 5%, 1/4 W		A-B	CB 6825	2
S1	Switch, Rotary, 12 position BCD	1702-0343			1
S2,S3,S4,S5	Switch, Rotary, 10 position BCD	1702-0344			4
S6	Switch, Rotary, 5 position	1702-0345			1
U1	Integrated Circuit		SIG	N74157B	1
U2,U3,U4 U6,U7,U8	Integrated Circuit		SIG	7403	6
U9	Integrated Circuit		SIG	7400	1
U10	Integrated Circuit		SIG	N7404A	1
U11	Integrated Circuit		SIG	N7440AH	1
U12	Integrated Circuit		SIG	N7438A	1

PARTS LIST

DISPLAY AND CONTROL BOARD ASSY A - 4

REV. ____

REFERENCE SYMBOL	DESCRIPTION	COMETRON PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
U13	Integrated Circuit		SIG	N7416A	1
U14,U15,U16 U17,U18	Integrated Circuit		SIG	N7447B	5
XDCR1, XDCR2, XDCR3, XDCR4, XDCR5, XDCR6	Socket, I.C.		AUG	314AG5F-3R	6
	Cable Assembly	1752-0359-1			1
	Cable Assembly	1752-0359-2			1
E1,E2,E3	Test Point		CAM	460-2970-02-03	3
	Printed Circuit Board	1934-0317			1

PARTS LIST

DISPLAY AND CONTROL BOARD
ASSY A - 4

REV. ____

REFERENCE SYMBOL	DESCRIPTION	COMSTRON PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
C1,C3,C4	Capacitor, Ceramic .01uF, 100V		RMC	Type TA	3
C2	Capacitor, Tantalum 15uF, 20 V		KEM	T368B156 M20AS	1
CR1,CR2 CR3,CR4 CR5,CR6 CR7,CR8	Diode, Silicon		MOT	IN914	8
DCR1,DCR2 DCR3,DCR4 DCR5,DCR6	LED Display, 7 Segment		HP	5 082-7730	6
DCR7,DCR8 DCR9,DCR10 DCR11,DCR12 DCR13	Diode, Light Emitting		MON	MV-5153	7
R1,R2,R3,R4 R5	Resistor Pack, 470 ohm, 5%, 1/4 W		A-B	34B4714	5
R6,R7,R8 R9,R10,R11	Resistor Pack, 6.8K, 5%, 1/4 W		SOL	RNIL682 DA	6
R12,R13,R14 R15,R16,R17 R23	Resistor, Composition, 470 ohm, 5%, 1/4 W		A-B	CB 4715	7
R18,R19,R20 R24,R25,R26	Resistor, Composition, 220 ohm, 5%, 1/4 W		A-B	CB 2215	6
R21,R22	Resistor, Composition, 6.8K, 5%, 1/4 W		A-B	CB 6825	2
S1	Switch, Rotary, 12 position BCD	1702-0343			1
S2,S3,S4,S5	Switch, Rotary, 10 position BCD	1702-0344			4
S6	Switch, Rotary, 5 position	1702-0345			1
U1	Integrated Circuit		SIG	N74157B	1
U2,U3,U4 U6,U7,U8	Integrated Circuit		SIG	7403	6
U9	Integrated Circuit		SIG	7400	1
U10	Integrated Circuit		SIG	N7404A	1
U11	Integrated Circuit		SIG	N7440AH	1
U12	Integrated Circuit		SIG	N7438A	1

PARTS LIST

DISPLAY AND CONTROL BOARD ASSY A - 4 REV. ____

REFERENCE SYMBOL	DESCRIPTION	COMSTRON PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
U13	Integrated Circuit		SIG	N7416A	1
U14,U15,U16 U17,U18	Integrated Circuit		SIG	N7447B	5
XDCR1, XDCR2, XDCR3, XDCR4, XDCR5, XDCR6	Socket, I.C.		AUG	314AG5F-3R	6
	Cable Assembly	1752-0359-1			1
	Cable Assembly	1752-0359-2			1
E1,E2,E3	Test Point		CAM	460-2970-02-03	3
	Printed Circuit Board	1934-0317			1

PARTS LIST

FRONT PANEL
ASSY. A - 5

REV. ____

REFERENCE SYMBOL	DESCRIPTION	COMSTRON PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
S1	Switch, Toggle SPST		C-H	8280K27C	1
DS1,DS2,DS3	Lamp, 2.5V, .2A		G-E	1767	3
XDS1,XDS2 XDS3	Socket, Lamp		LEE	16-26	3
AT 101	Attenuator	1742-0360			1
M101	Meter, Output	1702-0316			1
J102,J602	Connector, BNC		APL	31-010	2
R158	Resistor, Variable		A-B	70A3N048 P-02U	1

PARTS LIST

REAR PANEL
ASSY. A-6

REV. ____

REFERENCE SYMBOL	DESCRIPTION	COMSTRON PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
C1, C2	Capacitor, Ceramic, .01uF, 1000V		RMC	Type B	2
S2	Switch, Slide DPDT 115V/230V		S-1	46256-LFR	1
T1	Transformer, Power	1703-0357			1
XF1	Fuseholder		LIT	342022	1
Q1, Q4	Transistor, NPN		MOT	MJE3055	2
Q2	Transistor, PNP		MOT	MJE2955	1
	Power Cord		BEL	17236	1
	Cord Wraps		VEM	CA-95	2

PARTS LIST

OPTION 001
REMOTE FREQUENCY PROGRAMMING REV. ____

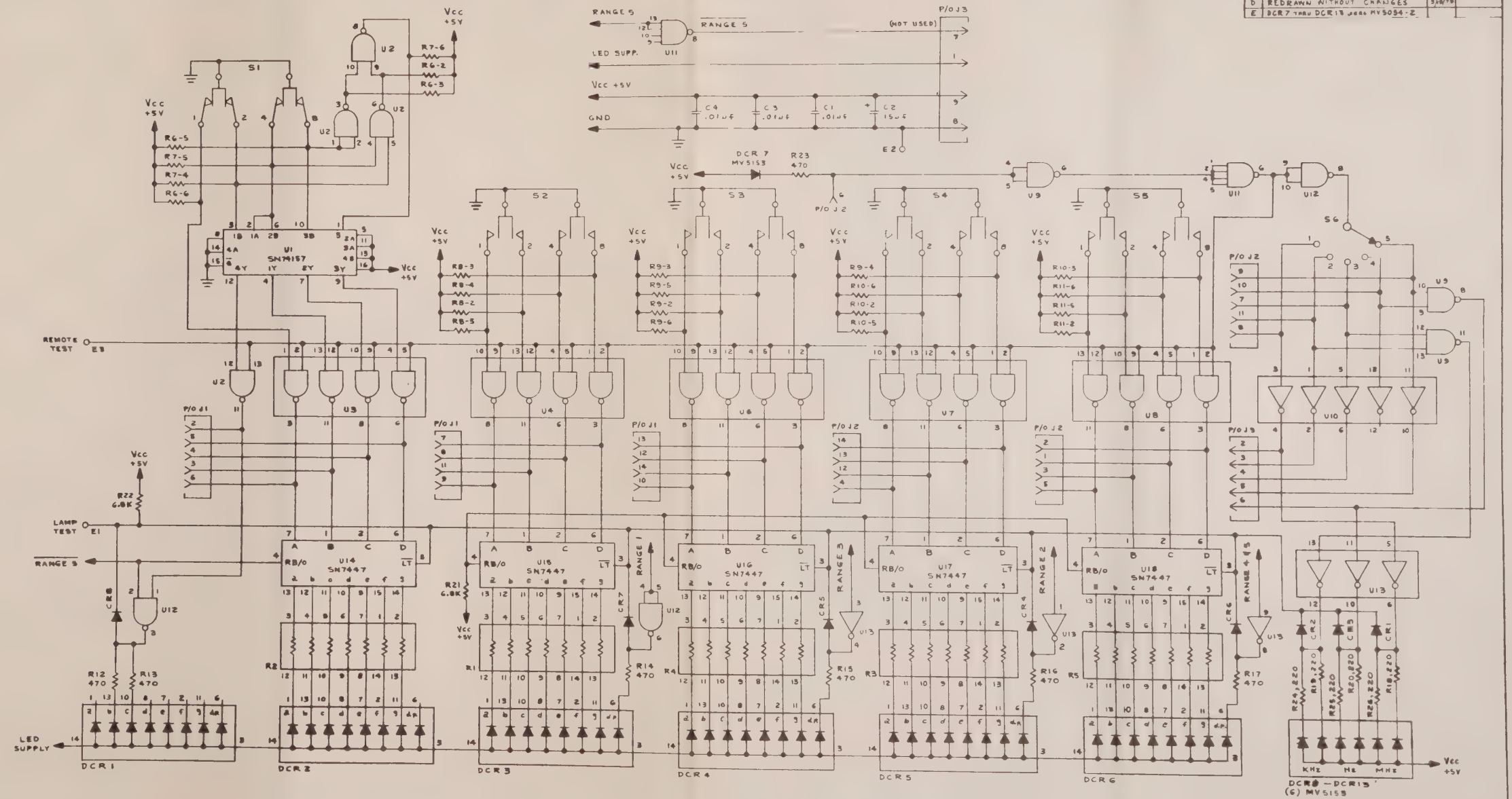
REFERENCE SYMBOL	DESCRIPTION	COMSTRON PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
C1,C2,C3,C4 C5,C8,C11, C17,C18,C19	Capacitor, Disc, Ceramic, .01uF, 100V		RMC	Type A	10
C9,C12	Capacitor, Mica, 470pF, 5%, 100V			DM15DA471 JO	2
C10	Capacitor, Monobloc, Ceramic, .47uF, 50 V		ERIE	ET06-000Z 5U0474M	1
C16	Capacitor, Tantalum, 15uF, 25 V		KEM	T368B156 MO20AS	1
CR1,CR2, CR3,CR4	Diode			IN914	4
J1,J2	Connector, P.C. 14 Pin		AUG.	514AG11D	
J4	Connector, Power		MOL.	09-18-5031	1
	Cable Assembly, Remote Input	1752-0377			1
	Cable Assembly	1752-0359-3			2
R1,R3,R5,R7 R9,R11,R13, R15,R17,R19 R21,R23,R25 R27,R29,R31 R33,R35,R37 R39,R41,R43 R45,R47,R73 R78,R81,R89, R86	Resistor, Fixed, Comp. 1.5K, 1/4 W, 5%		A-B	CB 1525	29
R2,R4,R6,R8 R10,R12,R14 R16,R18,R20 R22,R24,R26 R28,R30,R32 R34,R36,R38 R40,R42,R44 R46,R48,R79 R82, R87	Resistor, Fixed, Comp. 3.9K, 1/4 W, 5%		A-B	CB 3925	27
R75,R76,R77	Resistor, Fixed, Comp. 3.3K, 1/4 W, 5%		A-B	CB 3325	3
R84	Resistor, Fixed, Comp. 47K, 1/4 W, 5%		A-B	CB 4735	1
R92	Resistor, Fixed, Comp. 4.7K, 1/4 W, 5%		A-B	CB 4725	1
R80,R85	Resistor, Fixed, Comp. 33K, 1/4 W, 5%		A-B	CB 3325	2

PARTS LIST

OPTION 001
REMOTE FREQUENCY PROGRAMMING REV. ____

REFERENCE SYMBOL	DESCRIPTION	COMSTRON PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
U1,U3,U6,U8	Integrated Circuit		AMD	74LS174	4
U2,U4,U7,U9	Integrated Circuit		SIG	N7405A	4
U5,U20	Integrated Circuit		SIG	N7403AH	2
U10	Integrated Circuit		SIG	N74LS138B	1
U15,U16,U18	Integrated Circuit		SIG	N7400A	3
U17,U19	Integrated Circuit				2
	Printed Circuit Board	1933-0373			1
	Plug-In Board	1932-0375			1
	Clamp, Cable		WEC	TL-28	1

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
D	REDRAWN WITHOUT CHANGES	5/18/78	
E	DCR7 THRU DCR13 WERE MV5054-2		



NOTES:
UNLESS OTHERWISE INDICATED:
1. ALL DIODES ARE IN914.
2. ALL RESISTORS ARE ¼W, 5%
3. ALL UNMARKED RESISTORS ARE 6.8K, EXCEPT R1 THRU R6, WHICH ARE 470Ω, IN A DUAL-IN-LINE PACKAGE.

DCR1 THRU DCR6

DCR8 – DCR13

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRAC ± DEC ± ANGLES ±
MATERIAL
FINISH
NEXT ASSY
USED ON
APPLICATION
DO NOT SCALE THIS DRAWING
DRAWN
CHECKED
ENG APPD
MFG APPD
QUALITY APPD
APPROVED

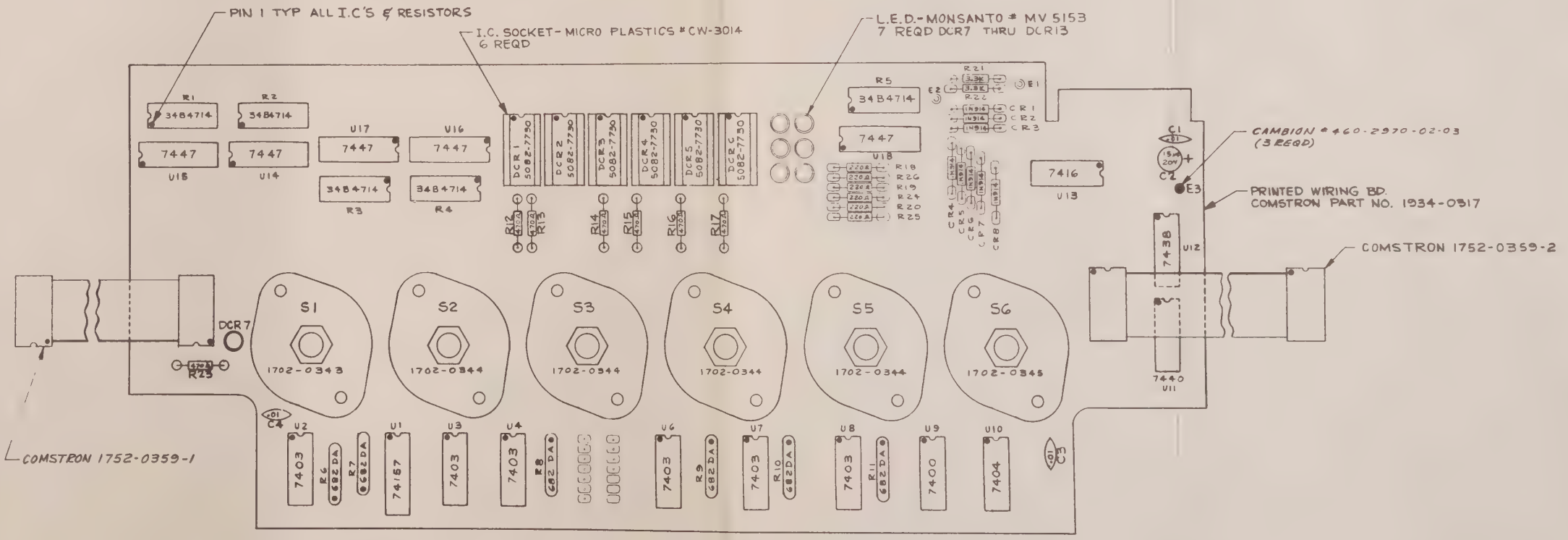
COMTREX CORPORATION

SCHEMATIC DIAGRAM, DISPLAY & CONTROLS

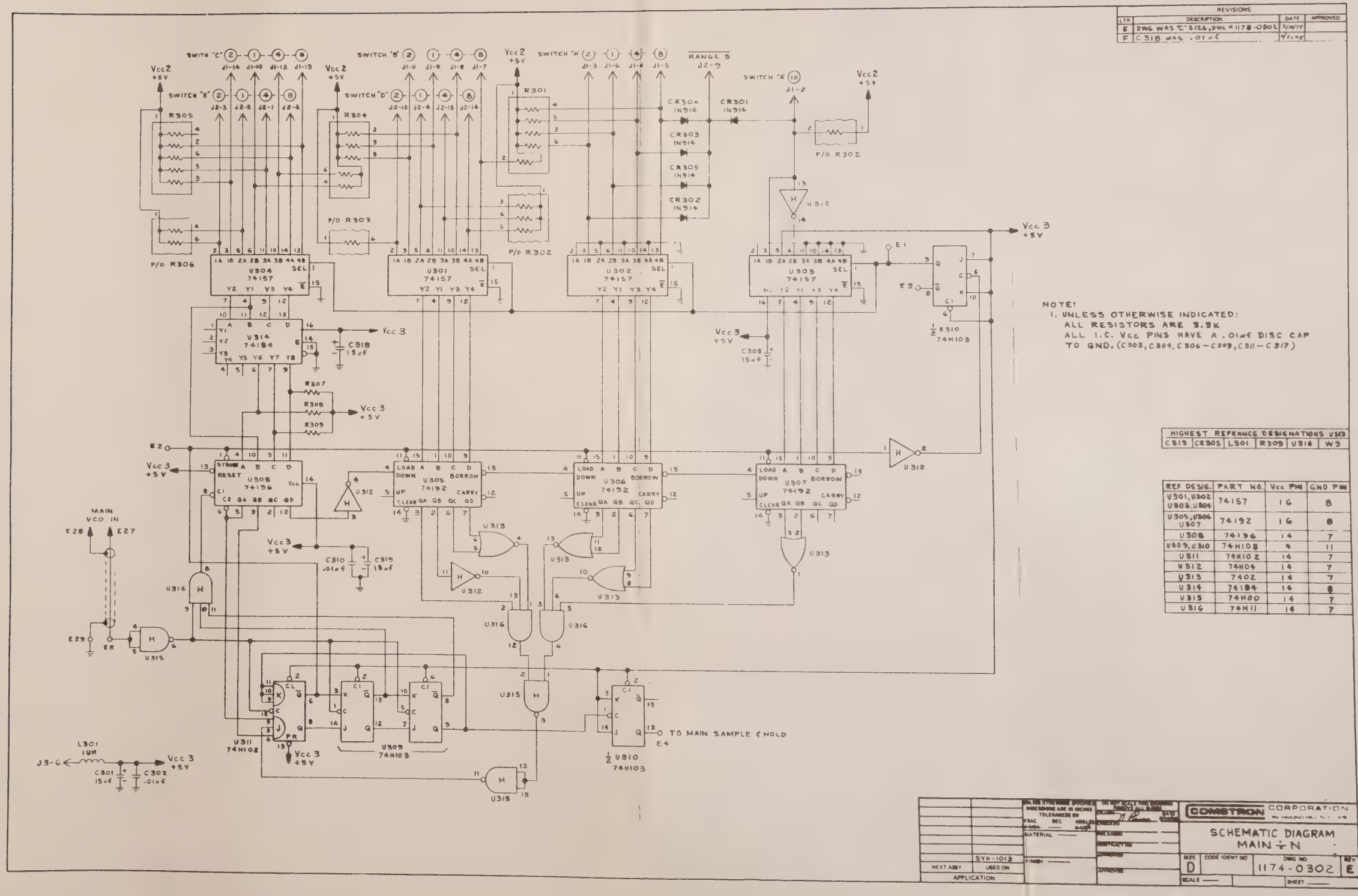
SIZE	CODE IDENT NO	DWG NO	REV
D		1174-0300	E

SCALE
SHEET

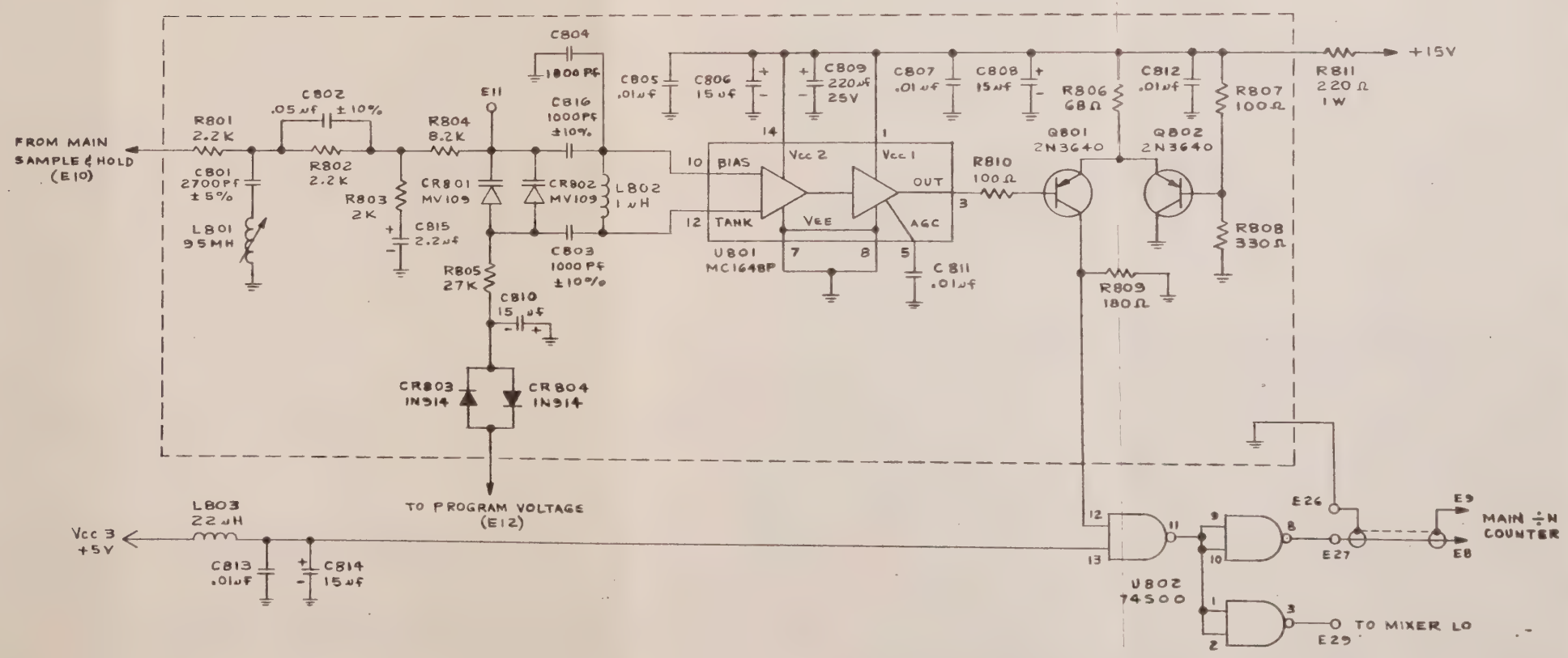
REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	DELETE U5, ADD (3) 220Ω	1/29/75	
B	DCR7-13 CHANGED, J1,J2 DELETED, CABLE ADDED	4/6/75	



		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRAC ± 1/64 DEC ANGLES ± 1/2°	DO NOT SCALE THIS DRAWING	COMSTRON CORPORATION	
		MATERIAL	DRAWN T. Lancaster 4/7/75	ASSEMBLY A4 DISPLAY & CONTROLS BOARD	
1944-0362 NEXT ASSY	STM-1018 USED ON	FINISH NONE	CHECKED / ENGR APPR. / MFG APPR. / QUALITY APPR. / MKTG APPR. / CONTRACT NO / APPROVED	SIZE D	CODE IDENT NO
APPLICATION				SCALE 2/1	DWG NO 1944-0328 REV
					SHEET


REVISIONS
LTR | DESCRIPTION | DATE | APPROVED
E | DWG WAS "C" 5126, DWG # 1178-0302 | 2/6/75
F | C318 WAS .01 uF | 4/24/75
SWITCH "C" (2)(1)(4)(8) J1-14 J1-10 J1-12 J1-13
SWITCH "B" (2)(1)(4)(8) J1-11 J1-9 J1-8 J1-7
SWITCH "A" (2)(1)(4)(8) J1-3 J1-6 J1-4 J1-5
RANGE 5 J2-9
SWITCH "K" (10) J1-2
SWITCH "E" (2)(1)(4)(8) J2-3 J2-5 J2-1 J2-2
SWITCH "D" (2)(1)(4)(8) J2-12 J2-4 J2-13 J2-14
Vcc2 +5V
Vcc 3 +5V
R301
R304
R305
P/O R302
P/O R303
P/O R306
CR304 IN914
CR303 IN914
CR305 IN914
CR302 IN914
CR301 IN914
U312
U304 74157
U301 74157
U302 74157
U303 74157
1A 1B 2A 2B 3A 3B 4A 4B SEL E Y2 Y1 Y3 Y4
U314 74184
C318 15uF
C305 15uF
R307
R308
R309
E1
E2
E3
1/2 U310 74H103
U308 74196
U305 74192
U306 74192
U307 74192
LOAD A B C D DOWN UP CLEAR BORROW CARRY QA QB QC QD
U313
U316
U315
U311 74H102
U309 74H103
1/2 U310 74H103
MAIN VCO IN
E26
E27
E29
E8
C310 .01uF
C319 15uF
L301 1UH
J3-6
C301 15uF
C302 .01uF
TO MAIN SAMPLE & HOLD
E4
NOTE:
1. UNLESS OTHERWISE INDICATED:
ALL RESISTORS ARE 3.3K
ALL I.C. Vcc PINS HAVE A .01uf DISC CAP TO GND. (C303, C304, C306–C309, C311–C317)
HIGHEST REFERENCE DESIGNATIONS USED
C319 | CR305 | L301 | R309 | U316 | W3
REF DESIG. | PART NO. | Vcc PIN | GND PIN
U301, U302, U303, U304 | 74157 | 16 | 8
U305, U306, U307 | 74192 | 16 | 8
U308 | 74196 | 14 | 7
U309, U310 | 74H103 | 4 | 11
U311 | 74H102 | 14 | 7
U312 | 74H04 | 14 | 7
U313 | 7402 | 14 | 7
U314 | 74184 | 16 | 8
U315 | 74H00 | 14 | 7
U316 | 74H11 | 14 | 7
SYN-1013
NEXT ASSY
USED ON
APPLICATION
CORNSTRON CORPORATION
SCHEMATIC DIAGRAM
MAIN ÷N
SIZE D
CODE IDENT NO
DWG NO 1174-0302
REV E
SCALE
SHEET

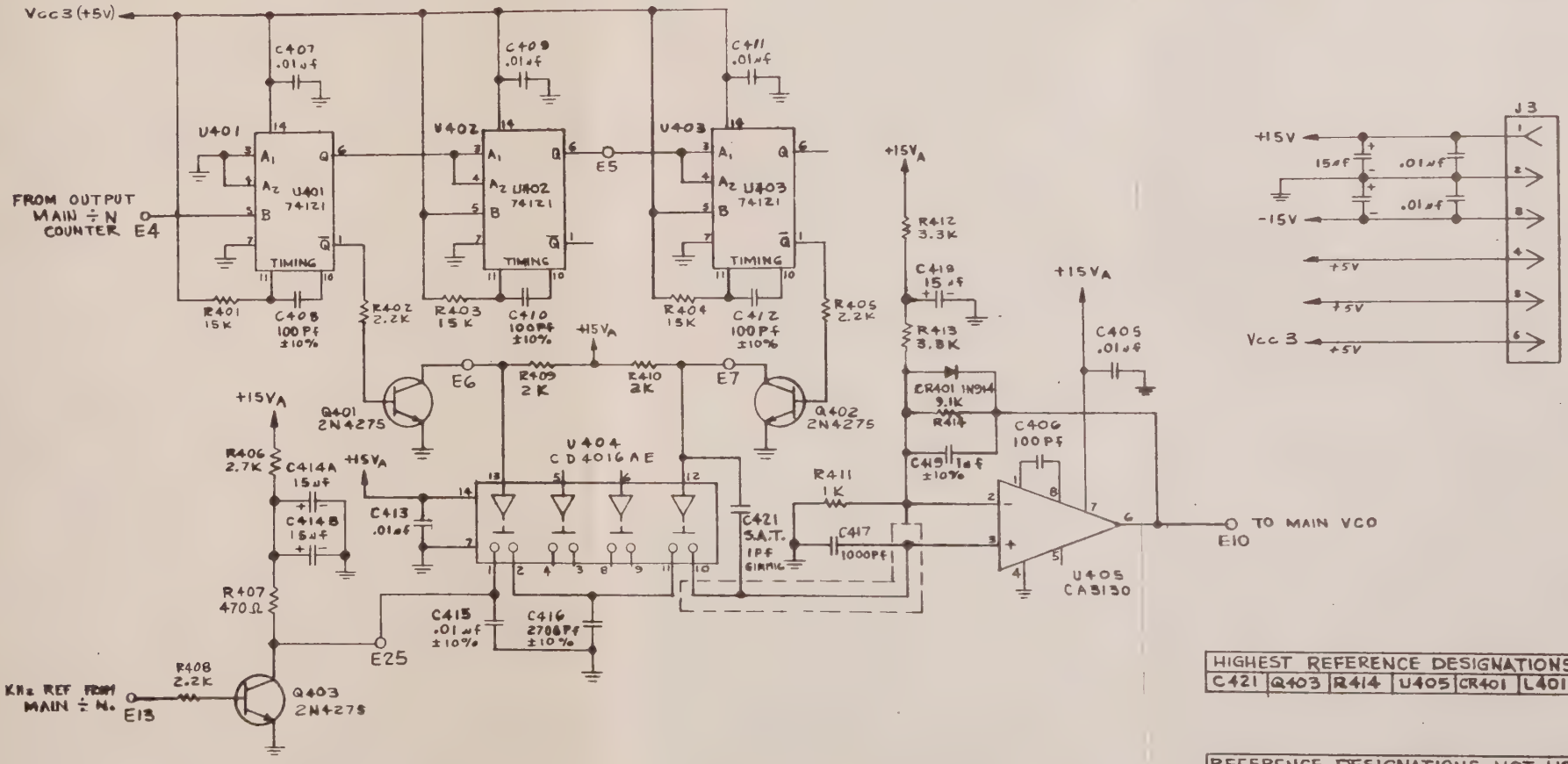
REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
F	R803 WAS 3.9K, SCHEMATIC REDRAWN	3/14/75	
G	C804 WAS .01 uf	6/26/75	



NOTE:
1. UNLESS OTHERWISE INDICATED ALL RESISTORS ARE $\frac{1}{4}$ W, 5%.

		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRAC. ±1/64 DEC. ANGLES ±1/2°	DO NOT SCALE THIS DRAWING REMOVE ALL BURRS	COMSTRON CORPORATION RICHMOND HILL N.Y. 11418	
		MATERIAL	DRAWN N. Romeo 3/14/75	SCHEMATIC DIAGRAM MAIN VCO	
			CHECKED		
			RELEASED		
			CONTRACT NO		
	SYN 1013	FINISH	APPROVED	SIZE C	CODE IDENT NO.
NEXT ASSY	USED ON		APPROVED	DWG. NO. 1173-0307	REV F
APPLICATION				SCALE	SHEET

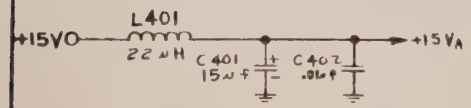
REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	DWG REVISED	1/1/73	
B	REVISED TO AGREE WITH PROD. BD	3/21/74	
C	U405 WAS NE536 C415 WAS .04 MF ADDED C421, E NOTES 1 & 2	6/22/74	
D	C416 WAS 1000 PF N.A.	9/27/74	
E	C415 WAS .005 N.A.	4/6/75	
F	REVISED VARIOUS PLACES	5/23/75	

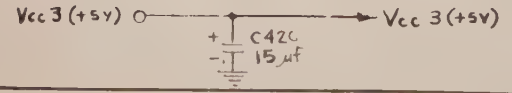


HIGHEST REFERENCE DESIGNATIONS USED						
C421	Q403	R414	U405	CR401	L401	

REFERENCE DESIGNATIONS NOT USED						

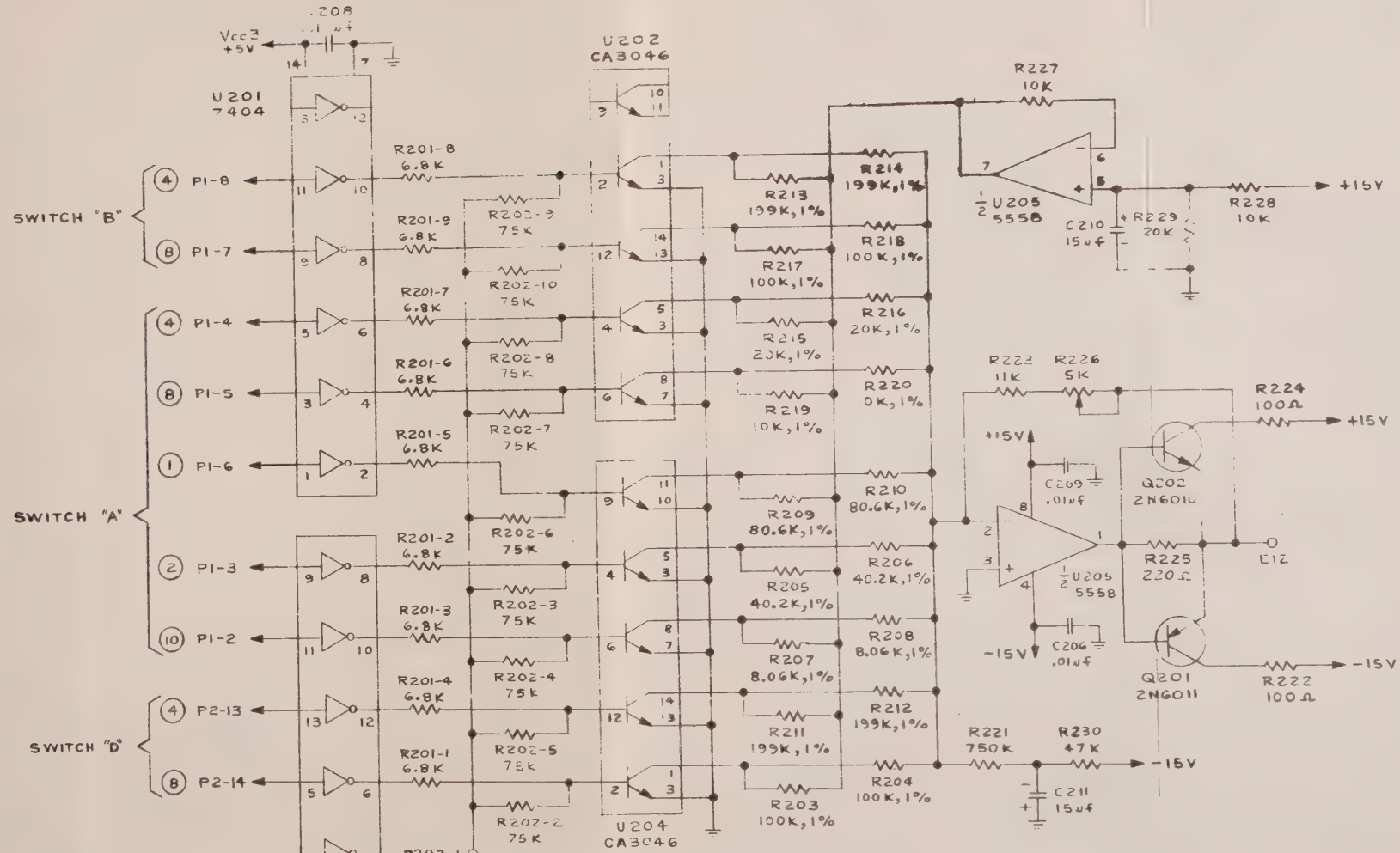
NOTES:
1. UNLESS OTHERWISE SPECIFIED ALL RESISTORS ARE 1/4W 5%.
2. CG21 IS SELECTED AT TEST (S.A.T.). - GIMMIC
3. ALL UNUSED PINS OF U404 ARE GROUNDED.





		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRAC. ± 1/64 DEC. ANGLES ± 1/2°	DO NOT SCALE THIS DRAWING REMOVE ALL BURRS	COMSTRON CORPORATION RICHMOND HILL, N.Y. 11418	
		MATERIAL:	DRAWN M Rapp DATE 1/1/73	SCHEMATIC DIAGRAM MAIN SAMPLE & HOLD	
			CHECKED C64 9/27/74		
		FINISH:	RELEASED		
	SYD 1013		CONTRACT NO.		
NEXT ASSY	USED ON		APPROVED	SIZE C / CODE IDENT NO / DWG NO. 1173 C303 / REV F	
APPLICATION			APPROVED	SCALE --- / SHEET ---	

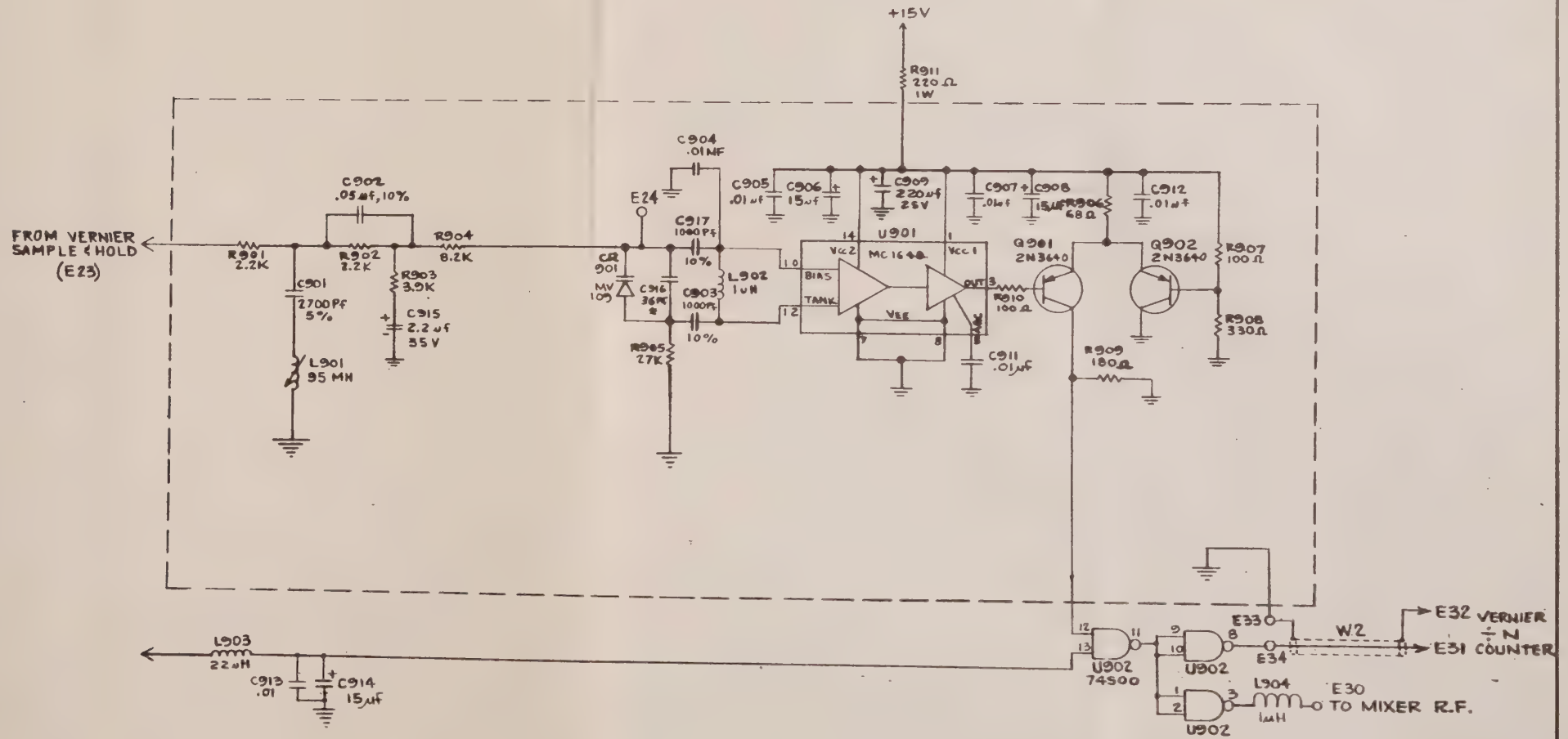
REVISIONS			
LTR	DESCRIPTION	DATE	
1	SCHEMATIC REDRAWN	3/13/76	



NOTE:
1. UNLESS OTHERWISE INDICATED: ALL RESISTORS ARE ¼W, 5%.

		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRAC. ±1/64 DEC. ANGLES ±1°	DO NOT SCALE THIS DRAWING REMOVE ALL BURRS	COMSTRON CORPORATION	
			DRAWN N. Howard 3/13/76	SCHEMATIC DIAGRAM, PROGRAM VOLTAGE	
		MATERIAL	CHECKED		
			RELEASED		
			CONTRACT NO		
	STN1013	FINISH	APPROVED A. Gray 3/16/76	SIZE C	CODE IDENT NO. DWG NO 1173-0301 REV E
NEXT ASSY	USED ON		APPROVED	SCALE	SHEET
APPLICATION					

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	DWG REVISED	1/7/74	CCH
B	DWG REVISED	2/15/74	CCH
C	REVISE TO AGREE WITH PROD. BD	3/21/74	CCH
D	REDESIGNED & REDRAWN (RME)	6/22/74	CCH
E	C915 ADDED, C916 REPLACES CR902 (M.R.)	9/27/74	CCH
F	ADDED L904	5/5/78	PC



NOTE:
UNLESS OTHERWISE SPECIFIED ALL RESISTOR ARE 1/4W 5%.
* SELECT AT TEST (S.A.T.)

HIGHEST REFERENCE DESIGNATIONS USED						
C917	CR901	Q902	R911	U902	L904	

REFERENCE DESIGNATIONS NOT USED								
C910								

	SYN 1013
	SYN 201
NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRAC. ± 1/64 DEC. ANGLES ± 1/2°
MATERIAL:
FINISH

DO NOT SCALE THIS DRAWING REMOVE ALL BURRS
DRAWN DATE
CHECKED
RELEASED
CONTRACT NO
APPROVED
APPROVED

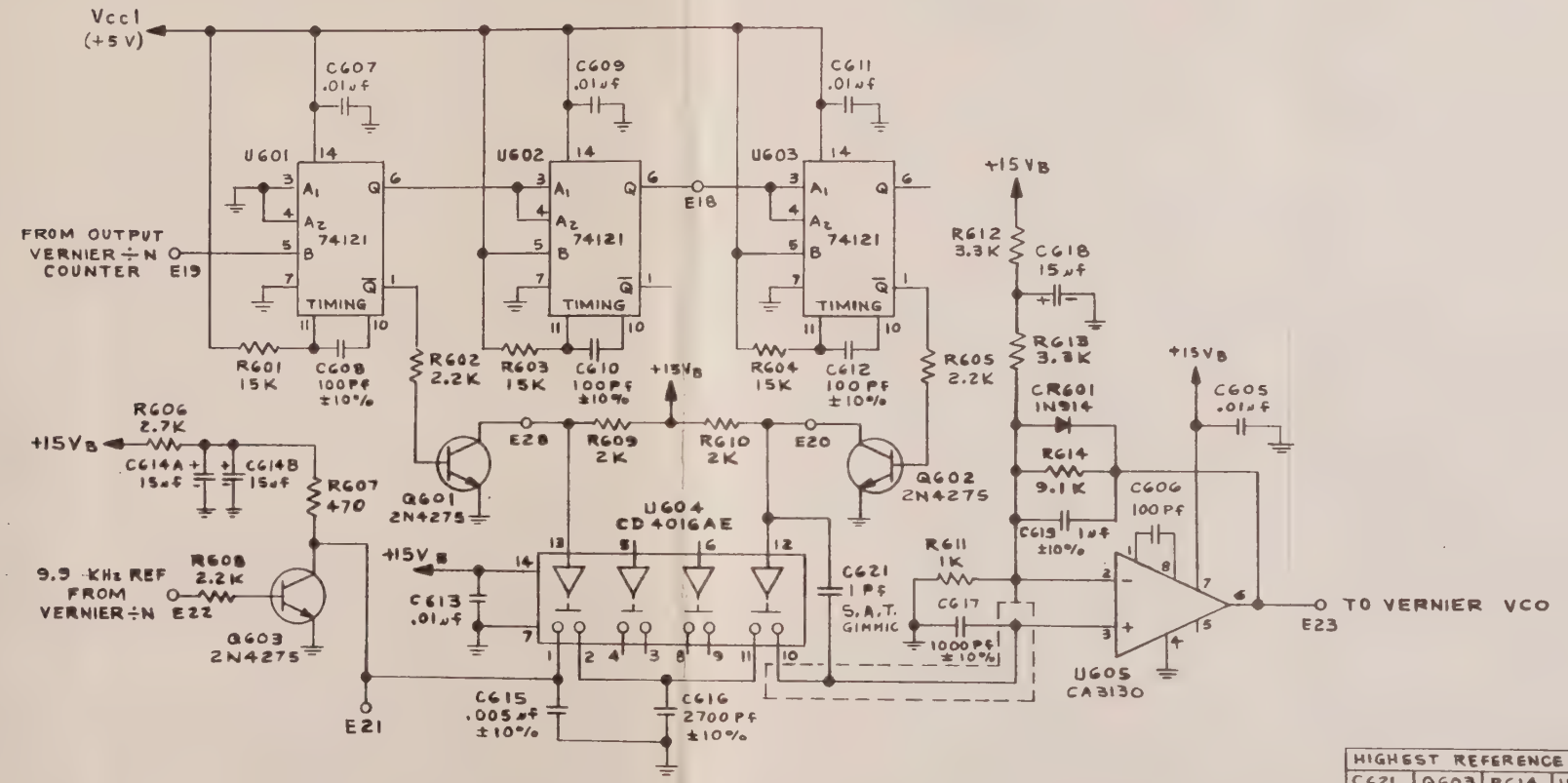
COMSTRON CORPORATION
RICHMOND HILL N Y 11418

SCHEMATIC DIAGRAM
VERNIER VCO

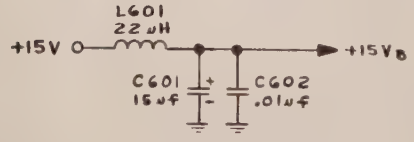
SIZE	CODE IDENT NO	DWG NO	REV
C		11/3-0308	F

SCALE
SHEET

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
E	REDRAWN WITHOUT CHANGES	2/10/75	
F	REVISED VARIOUS PLACES	5/22/75	



HIGHEST REFERENCE DESIGNATIONS USED						
C621	Q603	R614	U605	CR601	L601	



NOTES
1. UNLESS OTHERWISE INDICATED, ALL RESISTORS ARE 5%, ¼W.
2. C621 IS SELECTED AT TEST (S.A.T.) GIMMIC.
3. ALL UNUSED PINS OF U604 ARE GROUNDED.

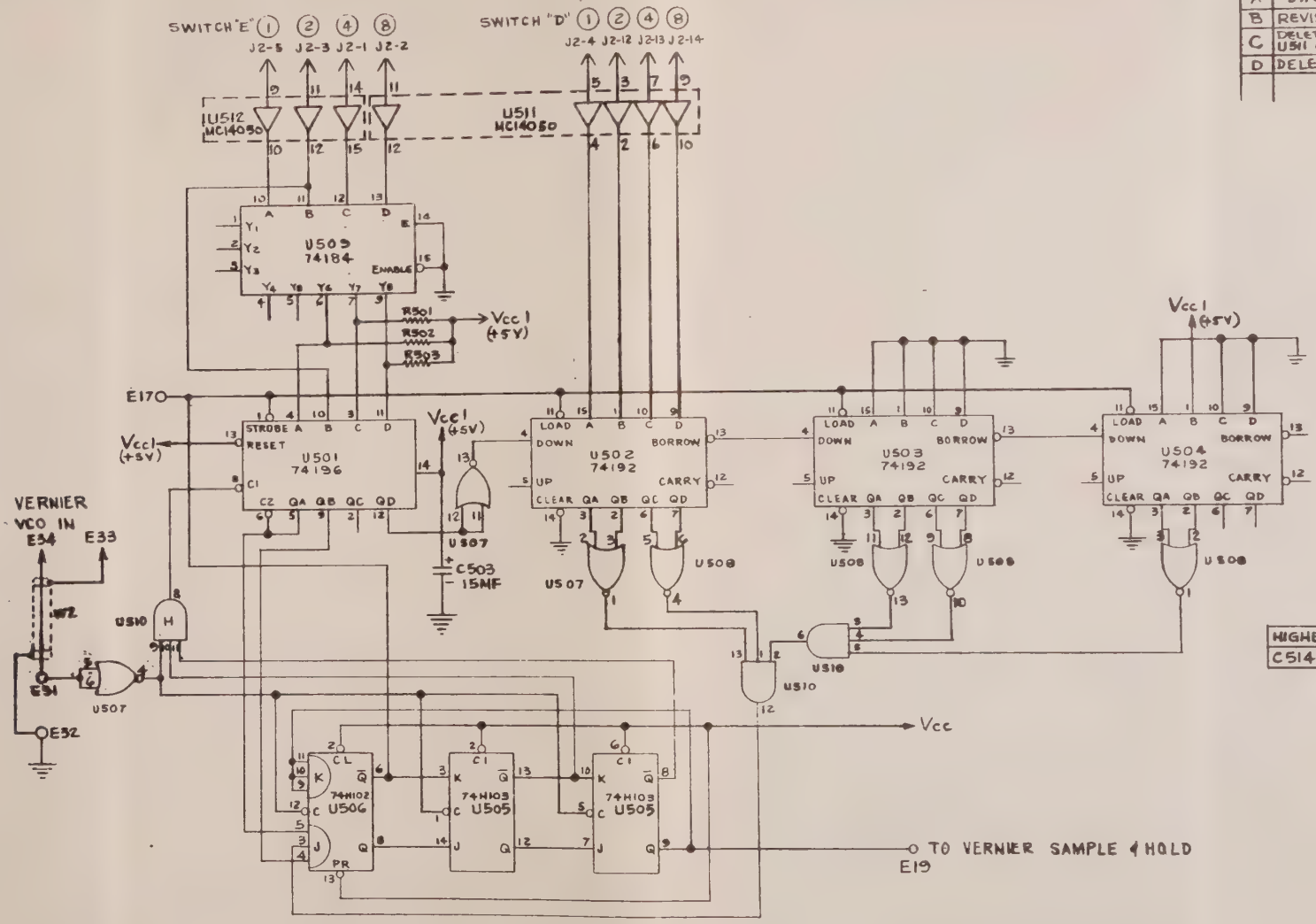
		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRAC. ±1/64 DEC. — ANGLES ±1/2°	DO NOT SCALE THIS DRAWING REMOVE ALL BURRS
		MATERIAL:	DRAWN DATE 3/10/75
		FINISH:	CHECKED
			RELEASED
			CONTRACT NO
			APPROVED
	SYN-1013		APPROVED
NEXT ASSY	USED ON		
APPLICATION			

COMSTRON CORPORATION

SCHEMATIC DIAGRAM
VERNIER SAMPLE & HOLD

SIZE	CODE IDENT NO	DWG NO	REV
C		1173-0305	F

SHEET



REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	DWG REVISED	1/7/74	CRL
B	REVISED TO AGREE WITH PROD. BD.	3/22/74	CRL
C	DELETED E26, ADDED E31 THRU E34; U511 & U512. RWF	4/22/74	CRL
D	DELETED "H" FROM U507	10/29/74	R. Kay

HIGHEST REFERANCE DESIGNATIONS USED			
C514	U512	R503	L501

REF. DESIG	PART NO.	Vcc PIN NO	Gnd PIN No.
U501	74196	14	7
U502, U503 U504	74192	16	8
U505	74H103	4	11
U506	74H102	14	7
U507	7450 2	14	7
U508	7402	14	7
U509	74184	16	8
U510	74H11	14	7
U511, U512	MC14050	1	8

REFERANCE DESIGNATIONS NOT USED
C502

NOTE:
1. ALL I.C. VCC PINS EXCEPT U501 HAVE A .01 MF DISC CAP. TO GND. C504 THRU C514.
2. UNLESS OTHERWISE SPECIFIED; ALL RESISTORS ARE 3.3K.

NEXT ASSY	USED ON	SYN 1013	
APPLICATION			

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRAC ± 1/64 DEC. ANGLES ± 1/2°
MATERIAL
FINISH

DO NOT SCALE THIS DRAWING REMOVE ALL BURRS
DRAWN DATE 6/5/73
CHECKED 9/27/74
RELEASED
CONTRACT NO
APPROVED
APPROVED

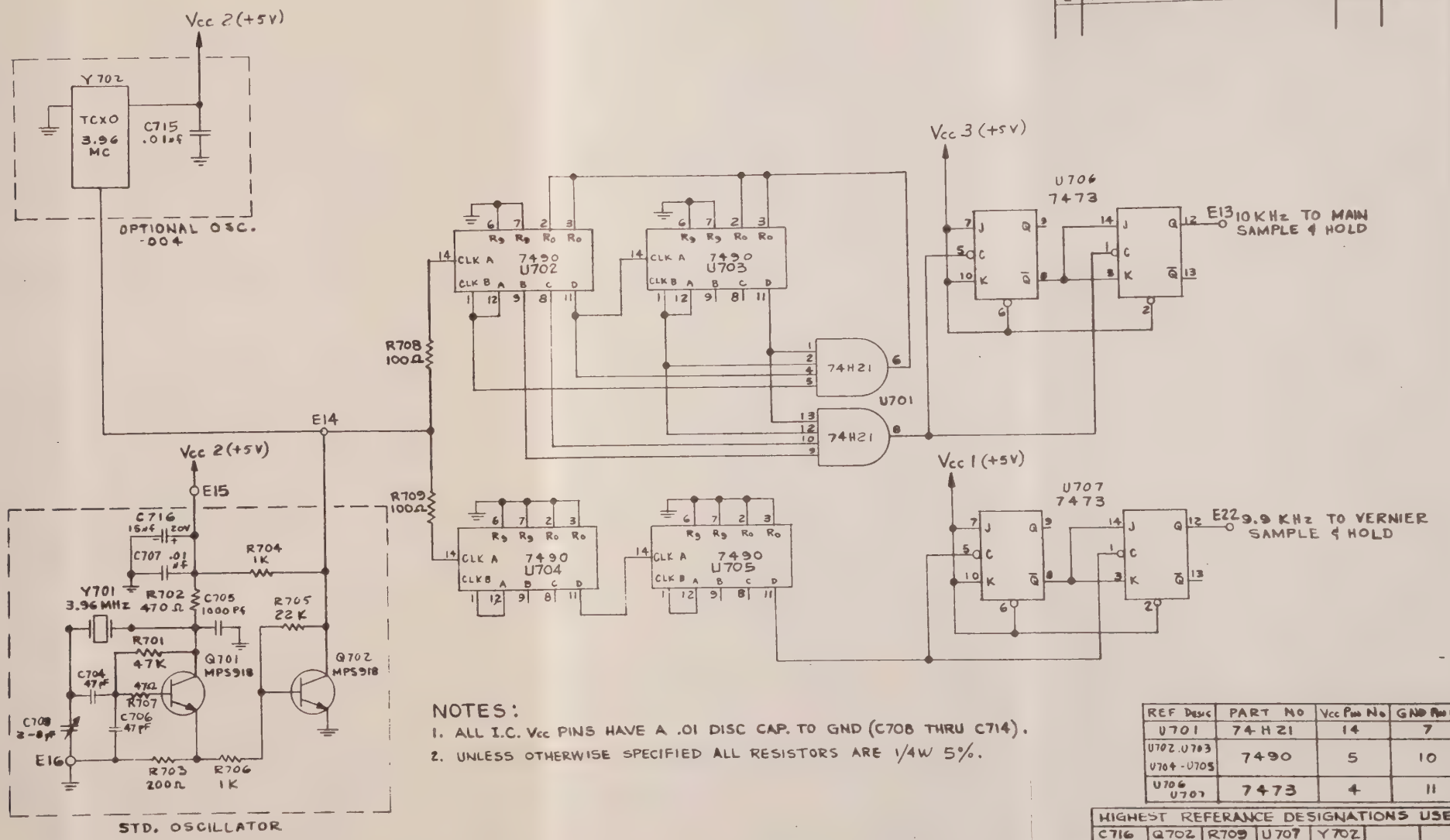
COMSTRON CORPORATION
RICHMOND HILL, N.Y. 11418

SCHEMATIC DIAGRAM
VERNIER ÷ N

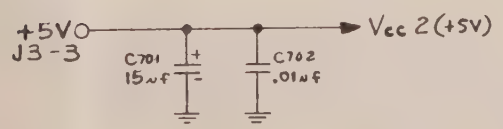
SIZE	CODE IDENT NO.	DWG. NO.	REV
C		1173-0304	D

SCALE
SHEET

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	DWG RELEASED	1/7/74	CEP
B	DWG REVISED	2/15/74	CEP
C	REVISED TO AGREE WITH PROD. BD.	3/22/74	CEP
D	ADDED R708 & R709	4/22/74	CEP
E	Q701, Q702 WERE 2N4275 (TK)	5/31/74	CEP



NOTES:
1. ALL I.C. Vcc PINS HAVE A .01 DISC CAP. TO GND (C708 THRU C714).
2. UNLESS OTHERWISE SPECIFIED ALL RESISTORS ARE 1/4W 5%.



REF DESIG	PART NO	Vcc PIN NO.	GND PIN NO.
U701	74H21	14	7
U702, U703, U704, U705	7490	5	10
U706, U707	7473	4	11

HIGHEST REFERANCE DESIGNATIONS USED						
C716	Q702	R709	U707	Y702		

REFERANCE DESIGNATIONS NOT USED

NEXT ASSY	USED ON
SYM-1013	
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON
FRAC. ± 1/64 DEC. ANGLES ± 1/2°
MATERIAL:
FINISH:

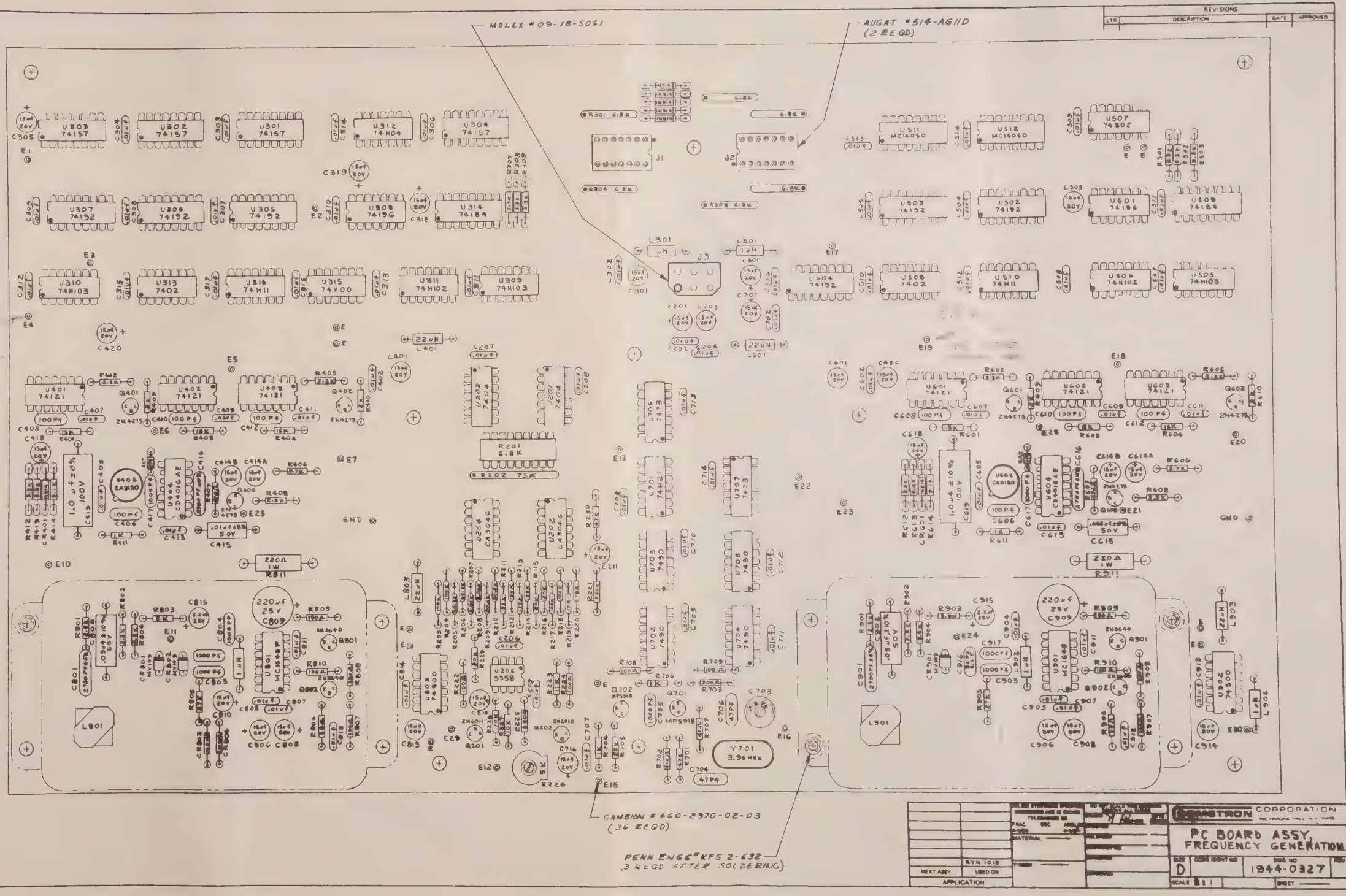
DO NOT SCALE THIS DRAWING REMOVE ALL BURRS
DRAWN DATE
CHECKED 9/27/74
RELEASED
CONTRACT NO
APPROVED
APPROVED

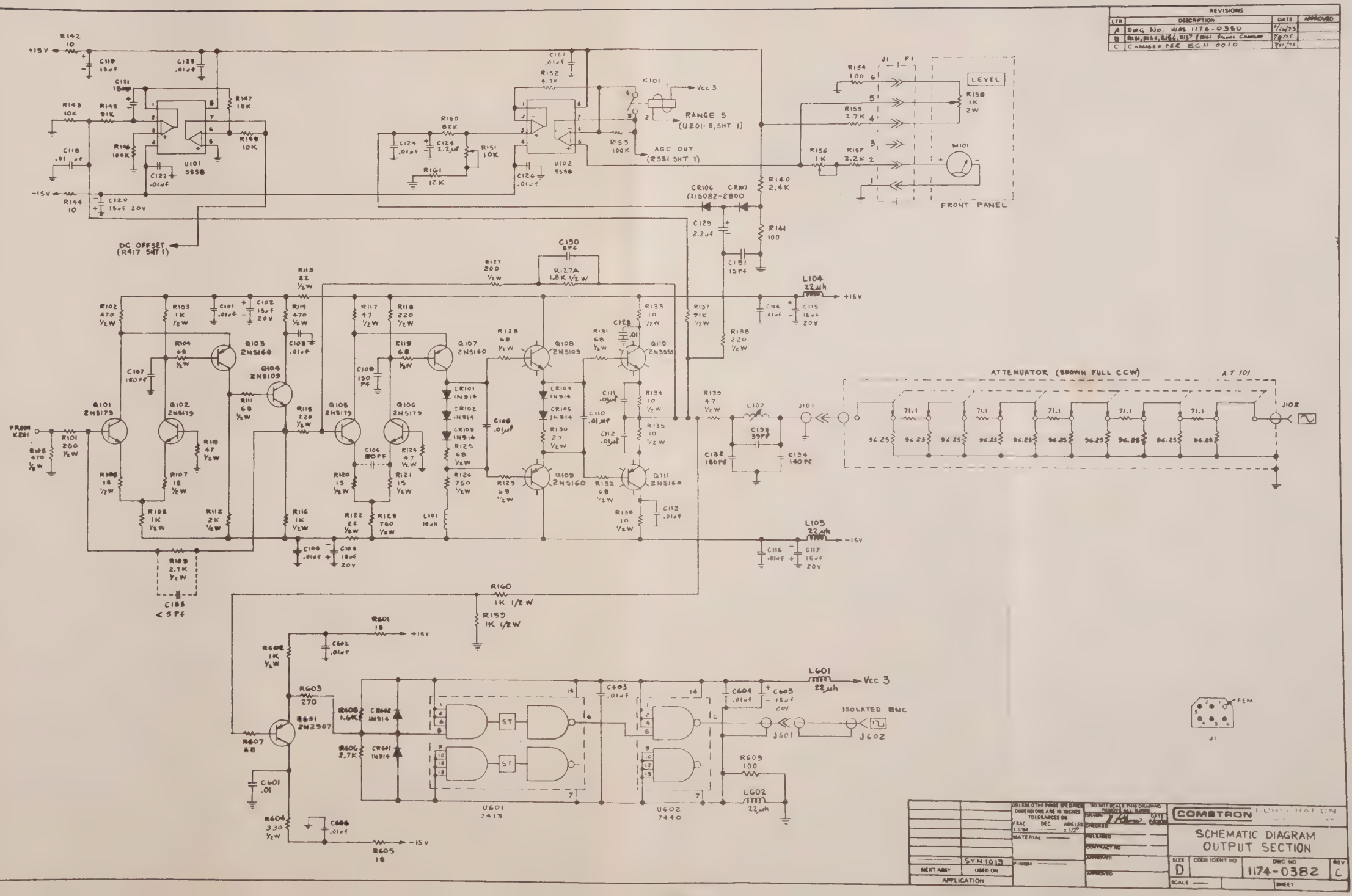
COMSTRON CORPORATION
RICHMOND HILL N.Y.

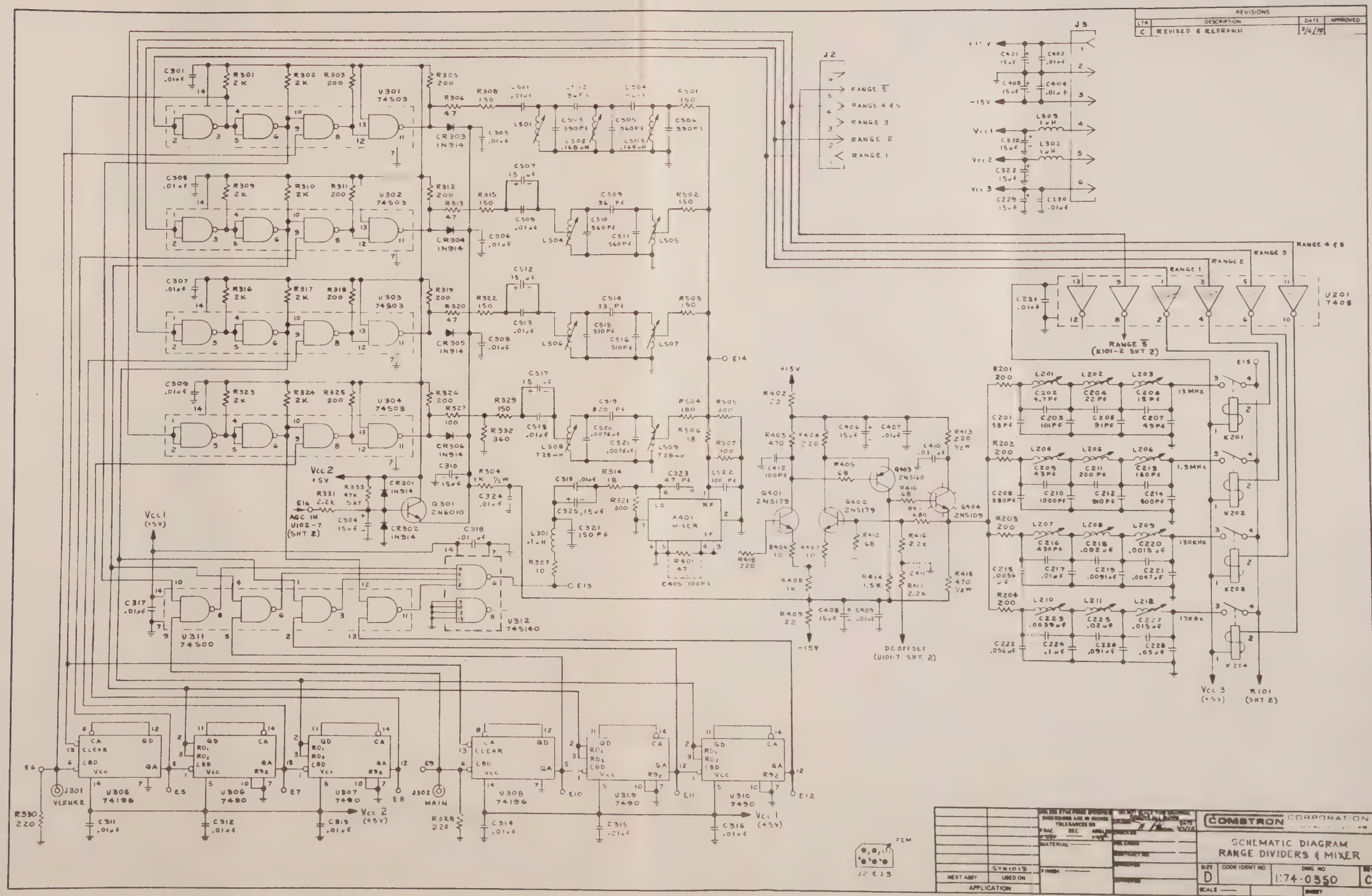
SCHEMATIC DIAGRAM CLOCK GENERATOR

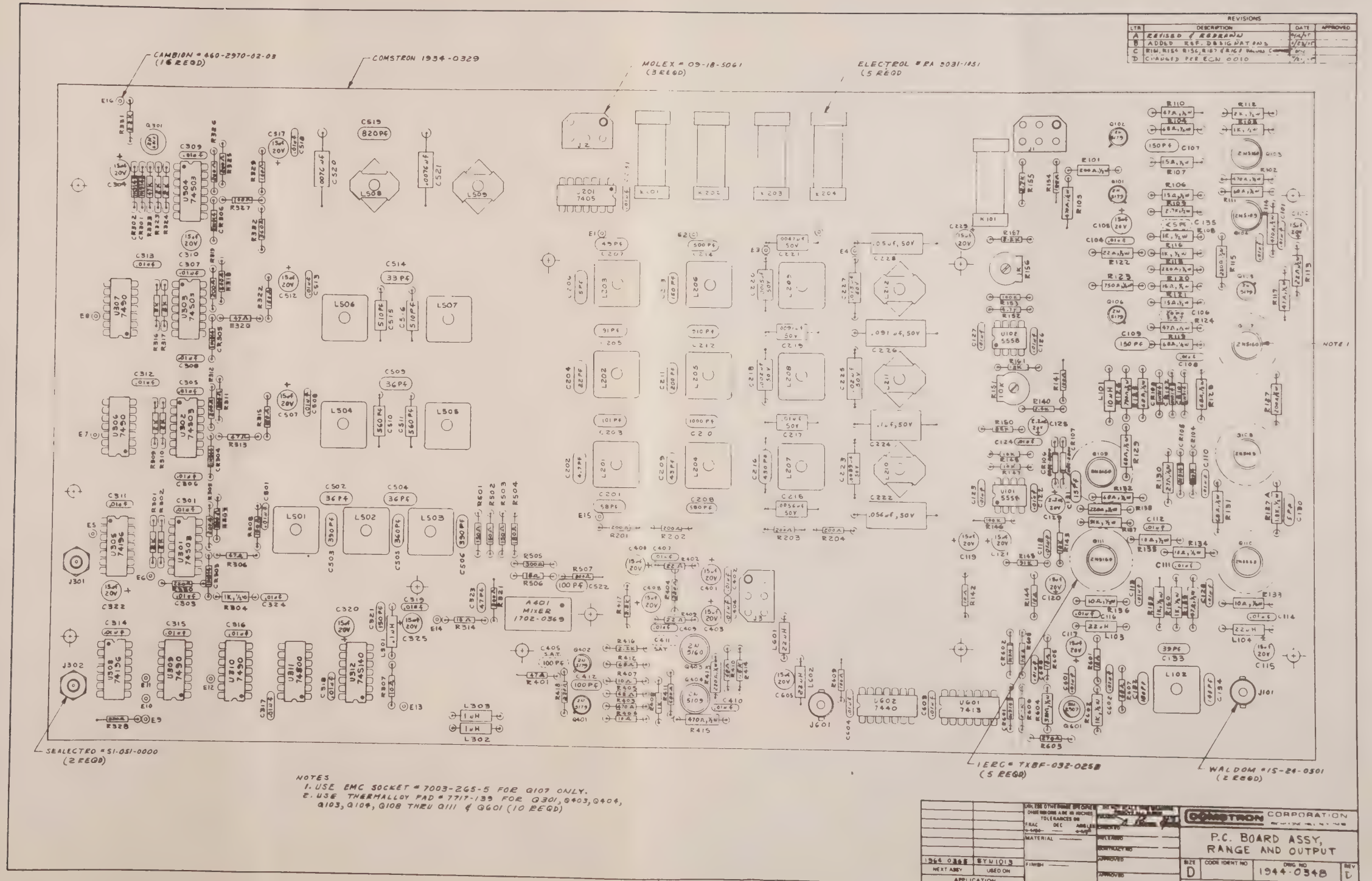
SIZE	CODE IDENT NO.	DWG. NO.	REV
C		1173-0306	

SCALE SHEET

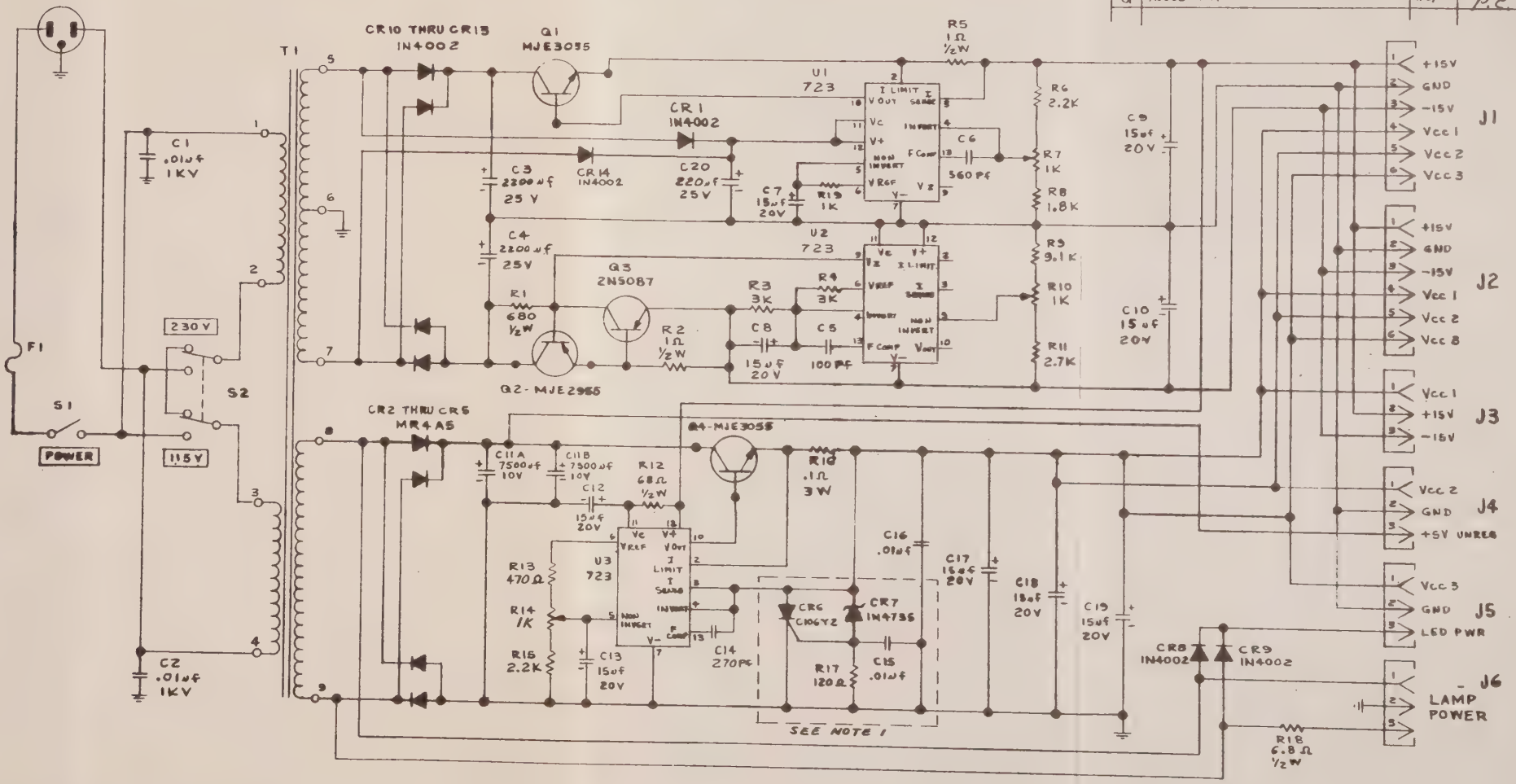

MOLEX # 09-18-5061
AUGAT #514-AG11D
(2 REQD)
REVISIONS
LTR
DESCRIPTION
DATE
APPROVED
CAMBION # 460-2970-02-03
(36 REQD)
PENN ENGG # KFS 2-632
(3 REQD AFTER SOLDERING)
CRESTRON CORPORATION
PC BOARD ASSY,
FREQUENCY GENERATION
1044-0327
SIZE D
SCALE 1:1
SHEET
MATERIAL
FINISH
NEXT ASSY
USED ON
APPLICATION


REVISIONS
LTR DESCRIPTION DATE APPROVED
A DOC No. WAS 1174-0380 9/24/73
B R154, R155, R156, R157 & R101 Values Changed 7/8/75
C CHANGED PER ECN 0010 9/2/75
+15V
-15V
RANGE 5 (U201-8, SHT 1)
AGC OUT (R331 SHT 1)
Vcc 3
DC OFFSET (R417 SHT 1)
FRONT PANEL
LEVEL
M101
J1 P1
CR106 CR107 (2)5082-2800
ATTENUATOR (SHOWN FULL CCW)
A7 J01
FROM KEY
ISOLATED BNC
J601
J602
J1
FEM
U101 5558
U102 5558
U601 7413
U602 7440
SCHEMATIC DIAGRAM
OUTPUT SECTION
COMSTRON
SIZE D
DWG NO 1174-0382
REV C
SCALE
SHEET
SYN 1013
NEXT ASSY
USED ON
APPLICATION


REVISIONS
LTR | DESCRIPTION | DATE | APPROVED
C | REVISED & REDRAWN | 3/6/78
J2
RANGE 5
RANGE 4
RANGE 3
RANGE 2
RANGE 1
J3
+11 V
-15V
Vcc 1
Vcc 2
Vcc 3
U301 74S03
U302 74S03
U303 74S03
U304 74S03
U311 74S00
U312 74S140
U305 74196
U306 7490
U307 7490
U308 74196
U309 7490
U310 7490
A401 MIXER
Q301 2N6010
Q401 2N5179
Q402 2N5179
Q403 2N5160
Q404 2N5109
U201 7405
AGC IN U102-7 (SHT 2)
DC OFFSET (U101-7 SHT. 2)
RANGE 5 (K101-2 SHT 2)
13MHz
1.3MHz
130KHz
13KHz
K201
K202
K203
K204
J301 VERNIER
J302 MAIN
J2 & J3
COMSTRON CORPORATION
SCHEMATIC DIAGRAM
RANGE DIVIDERS & MIXER
SIZE D
DWG NO 1174-0350
REV C
SCALE
SHEET


REVISIONS
LTR | DESCRIPTION | DATE | APPROVED
A | REVISED & REDRAWN
B | ADDED REF. DESIGNATIONS
C | R114, R154, R156, R157 CHANGE VALUES
D | CHANGED PER ECN 0010
CAMBION # 460-2970-02-03 (16 REQD)
COMSTRON 1934-0329
MOLEX # 09-18-5061 (3 REQD)
ELECTROL # EA 5031-1051 (5 REQD)
SEALECTRO # 51-051-0000 (2 REQD)
IERC # TXBF-032-025B (5 REQD)
WALDOM # 15-24-0501 (2 REQD)
A401 MIXER 1702-0369
NOTE 1
NOTES
1. USE EMC SOCKET # 7003-265-5 FOR Q107 ONLY.
2. USE THERMALLOY PAD # 7717-133 FOR Q301, Q403, Q404, Q103, Q104, Q108 THRU Q111 & Q601 (10 REQD)
COMSTRON CORPORATION
P.C. BOARD ASSY, RANGE AND OUTPUT
SIZE D
CODE IDENT NO
DWG NO 1944-0348
REV D
SCALE 2:1
SHEET
1944 0348 E
NEXT ASSY
BYM 1013
USED ON
APPLICATION

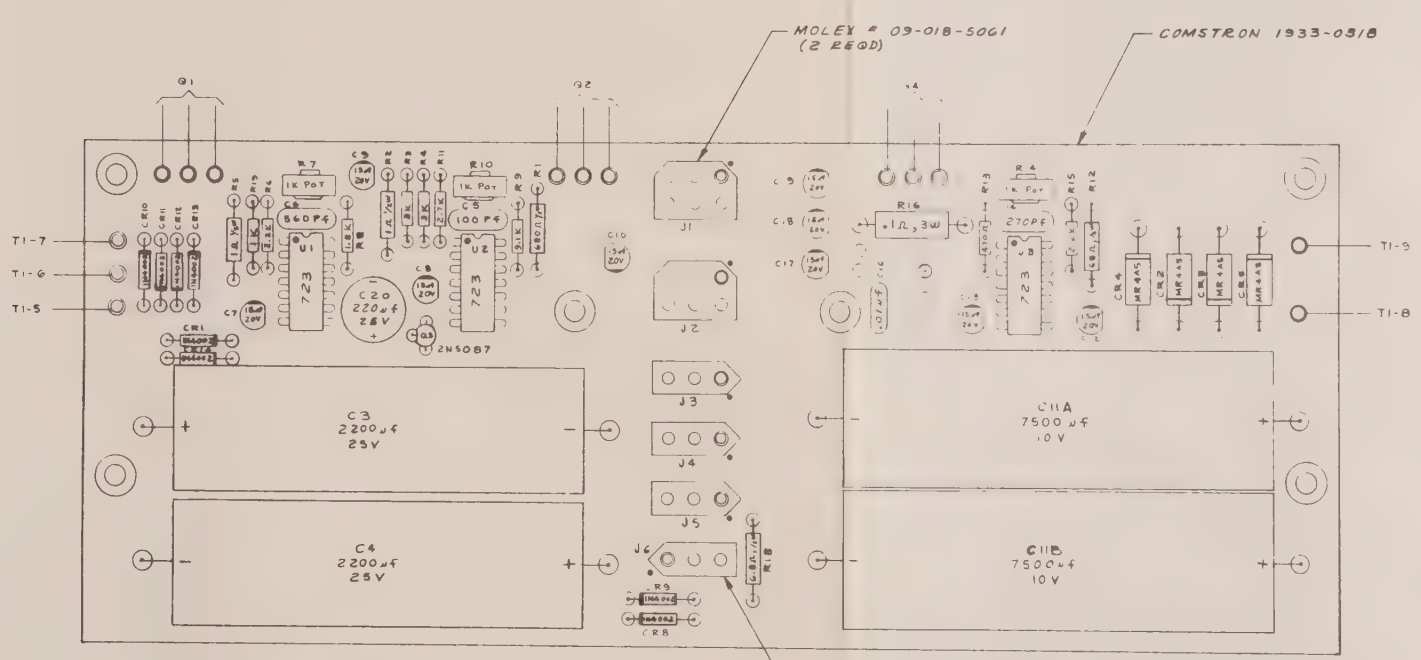
REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
B	REVISED & RELEASED	5/28/74	P.C.
C	VALUES REVISED, C8 ADDED	9/4/74	P.C.
D	C14 RELOCATED	9/21/74	P.C.
E	CR10 THRU 13 WAS CR1 (8376-S)	10/29/74	P.C.
F	ADDED: CR1, C20 & R19, CHANGED CR 8 THRU 13 FROM IN4001	1/15/75	P.C.
G	ADDED CR14	4/3/75	P.C.



NOTES:
1. COMPONENTS IN BOX NOT NORMALLY USED.

		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRAC. ±1/64 DEC. ANGLES ±1/2° MATERIAL: FINISH	DO NOT SCALE THIS DRAWING REMOVE ALL BURRS DRAWN DATE CHECKED 8/4/74 RELEASED CONTRACT NO APPROVED	COMSTRON CORPORATION SCHEMATIC DIAGRAM POWER SUPPLY
	SYN 1013			SIZE DWG NO REV G
NEXT ASSY	USED ON			

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	CHANGED TO AGREE WITH SCHEMATIC	7/24/73	
B	ADDED CR14	8/23/73	



MOLEX # 09-18-5031
(4 REQD)

NOTES:
1. FOR SCHEMATIC DIAGRAM SEE DWG. # 1179-0300.

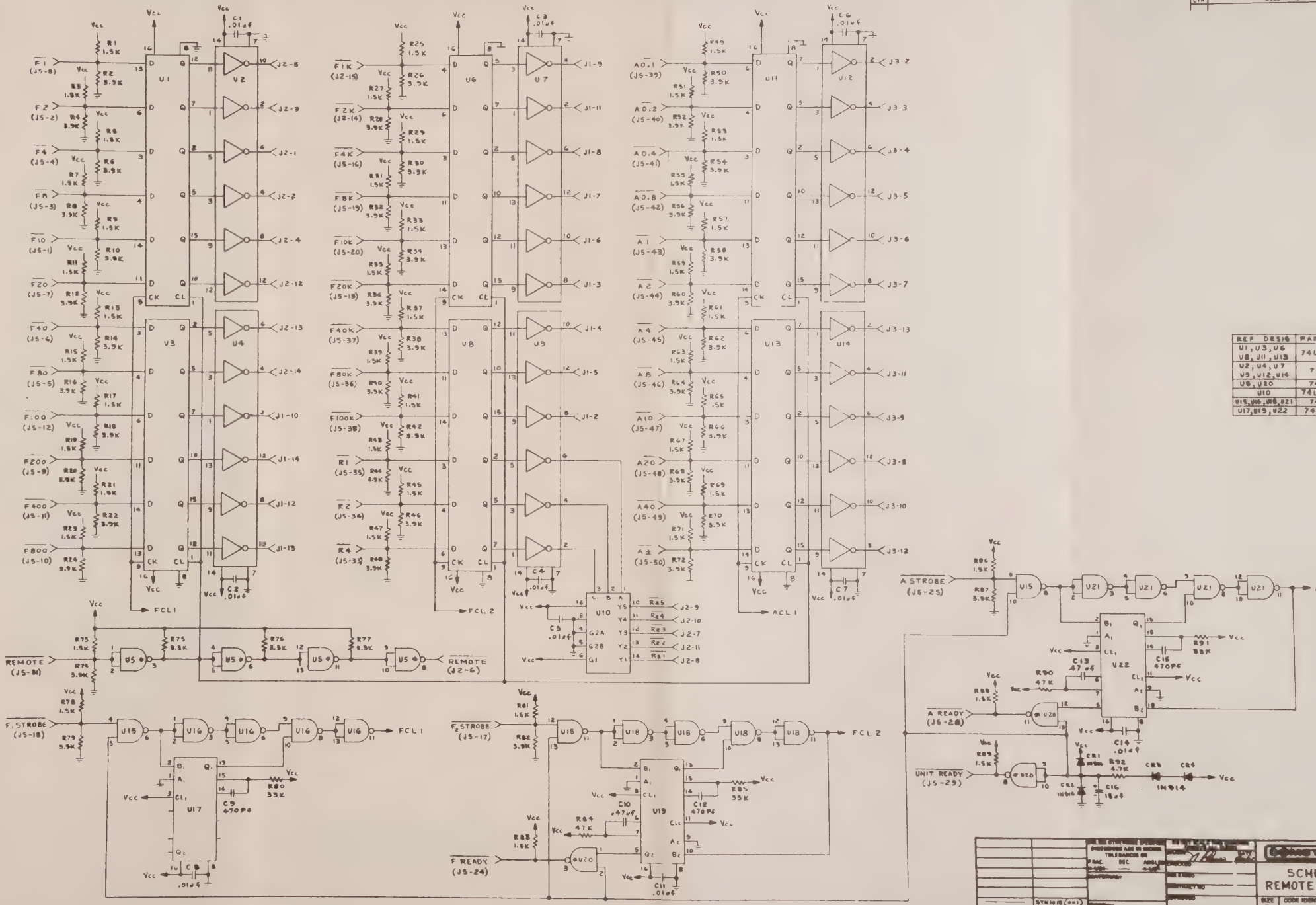
1944-0358	SYN 1013		
NEXT ASSY	USED ON		
APPLICATION			

COMSTRON CORPORATION

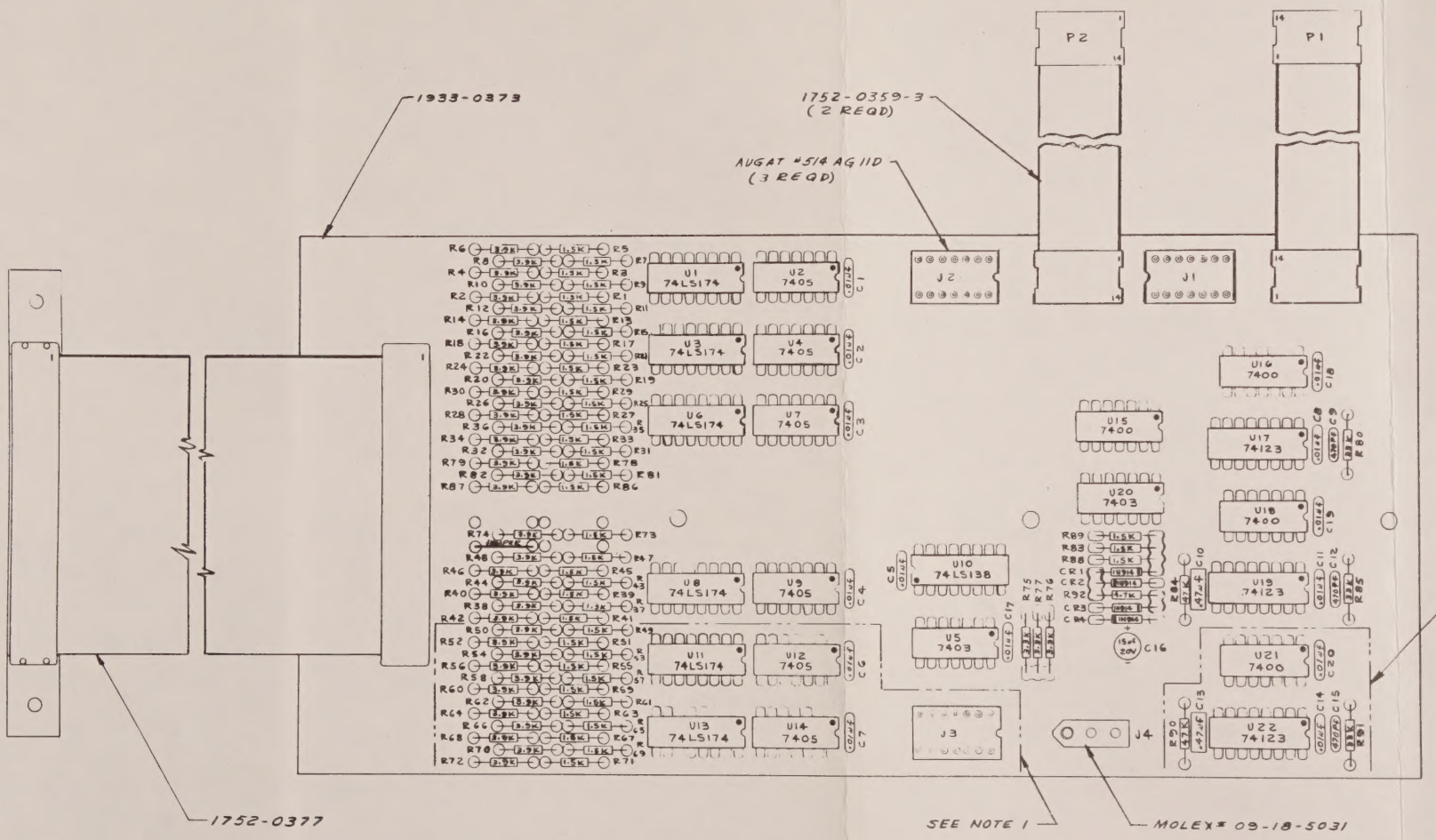
P.C. BOARD ASSY, POWER SUPPLY

SIZE	CODE IDENT NO	DWG NO	REV
D		1944-0337	B

SCALE 2:1 SHEET


REVISIONS
LTR | DESCRIPTION | DATE | APPROVED
REF DESIG | PART NO. | Vcc PIN | GND PIN
U1, U3, U6 | 74LS174 | 16 | 8
U8, U11, U13 | | |
U2, U4, U7 | 7405 | 14 | 7
U9, U12, U14 | | |
U5, U20 | 7403 | 14 | 7
U10 | 74LS138 | 16 | 8
U15, U16, U18, U21 | 7400 | 14 | 7
U17, U19, U22 | 74123 | 16 | 8
F1 (J5-8)
F2 (J5-2)
F4 (J5-4)
F8 (J5-3)
F10 (J5-1)
F20 (J5-7)
F40 (J5-6)
F80 (J5-5)
F100 (J5-12)
F200 (J5-9)
F400 (J5-11)
F800 (J5-10)
F1K (J2-15)
F2K (J2-14)
F4K (J5-16)
F8K (J5-19)
F10K (J5-20)
F20K (J5-13)
F40K (J5-37)
F80K (J5-36)
F100K (J5-38)
R1 (J5-35)
R2 (J5-34)
R4 (J5-33)
A0.1 (J5-39)
A0.2 (J5-40)
A0.4 (J5-41)
A0.8 (J5-42)
A1 (J5-43)
A2 (J5-44)
A4 (J5-45)
A8 (J5-46)
A10 (J5-47)
A20 (J5-48)
A40 (J5-49)
A80 (J5-50)
FCL1
FCL2
ACL1
REMOTE (J5-31)
REMOTE (J2-6)
F STROBE (J5-18)
F2 STROBE (J5-17)
F READY (J5-24)
A STROBE (J5-25)
A READY (J5-28)
UNIT READY (J5-29)
J2-5
J2-3
J2-1
J2-2
J2-4
J2-12
J2-13
J2-14
J1-10
J1-14
J1-12
J1-13
J1-9
J1-11
J1-8
J1-7
J1-6
J1-3
J1-4
J1-5
J1-2
J2-9
J2-10
J2-7
J2-11
J2-8
J3-2
J3-3
J3-4
J3-5
J3-6
J3-7
J3-13
J3-11
J3-9
J3-8
J3-10
J3-12
ACL 1
SCHEMATIC DIAGRAM
REMOTE PROG. (OPTION 001)
CRESTRON CORPORATION
SIZE D
DWG NO 1174-0372
REV
SCALE
SHEET
NEXT ASSY
USED ON
APPLICATION

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED



NOTE
1. COMPONENTS WITHIN "PHANTOM LINES" USED IN CONJUNCTION WITH OPTION 002 ONLY.

OPT 001	SYN1019
NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRAC ± DEC ± ANGLES ±
MATERIAL
FINISH
DO NOT SCALE THIS DRAWING REMOVE ALL BURRS
DRAWN DATE
CHECKED
RELEASED
CONTRACT NO
APPROVED
APPROVED

COMTRON CORPORATION

P.C. BOARD ASSY
REMOTE FREQ. & AMPL. PROG.
OPTION 001

SIZE	CODE IDENT NO	DWG NO	REV
D		1944-0378	

SCALE 2:1 SHEET